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## Contents



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## Notice to Authors

By action of the Board of Directors at our Cincinnati Meeting, due to the increased cost of cuts, it was decided to limit the funds in the budget available for this item to the Journal only and that all authors submitting material accompanied by pictures (or charts or tables so constructed that they must be made into cut form) for publication in the Research Quarterly, will be asked to incur the expense of having these cuts made. This policy is effective beginning with the October, 1943, issue of the Quarterly. The Association regrets taking this action but war restrictions on metal and a limited budget make this policy necessary.

## Membership Plans

Previous to July, 1943, individuals or organizations wishing to join the A.A.H.P.E.R. could do so during any month in the year. This meant that every month in the year addressograph plates had to be cut, expiration notices sent, and files brought up to date. This procedure was time consuming and costly.

In order to reduce the cost and increase efficiency in handling memberships, it was decided that all memberships received after July, 1943, would be entered as beginning in one of three months; i. e., October, January, or April. Many of the present memberships begin in one of these three months. Under the new plan memberships expire in September, December, or March. Adjustments will be made with persons whose present memberships are later transferred to begin in October, January, or April.

# Body Weights Optimal for Young Adult Women

By Abby H. Turner
*With Mathematical Collaboration by* Florence Kimball
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GOOD health is of the greatest importance to each individual. Reliable signs of its presence or of its approaching failure have been sought by the study of nearly all physiological functions. A simple indicator has long been recognized in body weight, especially in its rapid changes either up or down, but the use of any method implies the existence of standards. Several weight tables of the early years of this century endeavored to provide such standards from sex, age, and height alone. They were widespread and did perhaps harm as well as good since height was the only measurement necessary and further study has shown it to have only a low correlation with weight. In the main these tables were derived from the measurement of large numbers of university students or accepted candidates for life insurance, both groups in which the standards of health were not rigid. As examples of these tables mention may be made of the Medico-Actuarial tables (1912) which have been widely quoted.

The need for better standards has been recognized by many and attempts to establish them have proceeded in the main by one of two routes, either the measurement of large numbers of supposedly healthy persons and the use of averages of several dimensions manipulated in various ways or the more critical study of carefully selected though much smaller groups.

At Mount Holyoke College it was felt that what we needed to know was the weight most indicative of sound health for each individual student. The appearance of the Willoughby method in 1932 and its support by Shelton (1932) seemed to offer promise and we began in the fall of 1933 to measure our freshmen and to calculate their optimal weights according to this procedure. Through the ten years since that date the results have been distinctly helpful as one means of judging the health status of our entering students.

This paper reports the Mount Holyoke studies made by the Willoughby system; it suggests alterations by which that system is somewhat modified though not in its fundamental aim or principles; and it includes as a second prediction method a regression equation based on the measurements of a group of entering students, 241 in number, all presumably in good health and for the most part of

approximately correct weight. These procedures are compared with other systems. The paper relates only to young women. Our subjects have averaged between 18 and 19 years of age in successive years. They have been nearly all freshmen though each year a small number of students entering advanced classes has been included. The average height and weight are compared in Appendix 1 with those of similar groups recently studied. It is seen that our students are relatively tall and heavy.

## METHODS AND RESULTS

The Willoughby system is based on measurements of test groups of 52 young men and 20 young women "all of whom presented a general status of physique ranging by visual adjudgment from good to excellent," but of various body builds. The panel of measurements was selected from a long series previously studied as providing suggestive proportionate relationships. They approximate skeletal measurements as closely as possible and show with the exception of height relatively high correlations with the actual weight of these selected subjects.

The measurements employed by Willoughby as criteria of skeletal size are widths at three levels: biacromial, bi-iliac, and bitrochanteric; three girths: wrist, knee, and ankle, each taken on both right and left sides; and total height. For the measurements of widths and girths, tables are provided which convert these dimensions proportionately to a common equivalent, chosen by Willoughby as ankle girth. This equivalent ankle girth, representing the general width and thickness of the whole skeleton, is then converted by a table made from a study of many relationships into a weight factor which gives in pounds the weight of one inch of a cylindrical figure equivalent in cross sectional area to that of the optimal body and of a height equal to the height of the body. To secure the optimal weight this weight factor is multiplied by the actual height in inches. The original paper by Willoughby and that of Shelton should be consulted for further details.

All measurements except those of height and weight used in this study have been made by two observers whose techniques of measuring were carefully checked together each year. One observer, A. H. Turner, made perhaps 90 per cent of the measurements in the falls of 1933 to 1938 inclusive and all in 1941. The other observer was Dr. Charlotte Haywood, also of the Department of Physiology, Mount Holyoke College, to whom thanks are rendered for her cooperation. Height and weight were measured by members of the Department of Physical Education in their usual routine procedure.

Weights estimated as optimal by the Willoughby technique have been in use in the Medical Department of Mount Holyoke

College since 1933 and have been helpful in efforts to ascertain the status of unduly thin and fat girls and to check their progress toward better health. After two years of use it seemed that the optimal weights yielded by the Willoughby standard were somewhat low, so the tables were scrutinized and compared with the dimensions of our student group. The table for wrists was found not closely applicable and was altered to give a better correlation. As a result the optimal weights were perceptibly raised. No other change was made. This discrepancy in wrist girth may be due largely to a difference in measuring technique for Mr. Willoughby says (recent personal communication) that he measures the wrist with the tape barely impressing the skin whereas at Mount Holyoke the tape is drawn snugly around the wrist so as to give as nearly as possible a true skeletal measurement.

After six years of using the method the ideals prescribed still seemed rather low and a more thorough statistical study was inaugurated. From the whole number of students certain exclusions were made, namely those of racial groups unlike the general body of American students and those whose previous diseases had left crippling after effects.* A total of 1612 students entering in 1933 to 1938 inclusive provided measurements for study.

Miss Florence Kimball treated these figures statistically with the results given in Table 1** and nearly all of the other tables. The distributions shown by the scatter diagrams were of normal type, though often slightly skewed toward the larger end apparently because of an excess of overweights. Simple coefficients of correlation were determined for the various measurements with each other and with both actual and optimal weights. Multiple correlation coefficients for the seven measurements with actual and optimal weights were determined by the Kelley method and also by the Doolittle method. Refer to Table 2. It is natural that the coefficients, both simple and multiple, should be higher for the optimal weights since these are derived from the measurements.

Study of the results and knowledge of the students as measured revealed the high correlation of actual weight and knee girth to be not a true skeletal relationship but a misleading figure since the girth of knees is commensurate with general fatness whereas the other measurements change relatively little as fat increases. There is from this cause, however, undoubtedly some error in all the so-called skeletal measurements. It was decided to omit the knee measurement entirely. The multiple correlation coefficient for the six measurements with actual weight then became (Doolittle method) .8142, and with optimal weight .9312, both lower than

* See Appendix 2 for details.
** Tables and appendices will be found at end of article.

the coefficients when knees were included, but since the inclusion of the knee measurement was indefensible the lower coefficients are safer. Refer to Table 5.

Because a further testing of the changes in procedure was clearly desirable, the program with and without knees was carried out on the 1941 entrants, 241 in number after the usual omissions. Tables 3, 4, and 5 give the statistical results for this smaller sample.* The agreement with Tables 1 and 2 is close enough to warrant the conclusion that 241 cases constitute an adequate sample. The six individual classes included in the larger group of 1612 cases had also been examined separately and no wide discrepancies found between successive years. Concerning the importance of size of sample, additional data will be given further on.

All the Willoughby data were now studied and a comparison made of his small though highly selected series with our larger but fairly well-chosen group. We have each year a small number of students definitely below any good standard of weights and a somewhat larger number of those above standard. As a whole, however, the group is made up of conspicuously healthy young women suitable for use as a standard. After a comparison of our measurements with Willoughby's tables for the relationship of ankle girth with other girths and widths, it seemed desirable to alter the tables slightly, though retaining the original aim and method of derivation. The same was true for the table giving weight factors.

There has been much discussion in the literature as to the best thoracic measurement to use. Willoughby defends biacromial width whereas others have used chest depth, width, and girth.** The correlations for biacromial width were found in our data to be lower than those for other measurements. Refer to Tables 2 and 4. Chest depth, width, and girth for our group of 241 were therefore studied with the statistical results seen in Table 6. It is clear that in this case chest width is superior to depth, though at first sight chest girth looks better than either. Chest girth, however, seems an impossible measurement for women because of the interference of the highly variable mammary glands through a wide range of levels. In this we differ from McCloy (1936). It was decided to replace biacromial width, a measurement not only somewhat low in its correlations with others but also difficult to take accurately because of the easy alteration of shoulder position, by chest width which, while not too easy to take because of respiratory movements, is in most respects materially higher in its correlations.

Directions for taking all measurements, the necessary tables, and

* A brief study has been made of the data from the students entering in 1942. See Appendix 4.

** See Pryor (1940) McCloy (1936), Boillin (1930).

the method of calculating results for this modified method are given in Appendix 2. It is suggested that this procedure be called the Willoughby-Turner method. Calculation processes have been simplified by the omission not only of the knee measurement but also of Willoughby's weighting process for which in our experience no justification could be seen. See his original paper for details.

The statistical findings for the optimal weights derived by the Willoughby-Turner method for the 1941 entrants, 241 in number, are as follows:

| | |
|---|---|
| Mean weight | 127.17 |
| Standard deviation | 12.09 |
| Probable error | 8.15 |
| Coefficient of variation | 9.67 |

The mean of the optimal weights is thus about two pounds higher than by the original system, a change welcomed by the Medical Department and the Department of Physical Education at Mount Holyoke College. Simple and multiple correlation coefficients for this group of 241 students studied by the Willoughby-Turner method are given in Table 7.

It has been the custom to ask students whose actual weight was more than 7 per cent below or more than 15 per cent above their optimal to come for conference with the Medical Department in order to study the reason for their discrepancy. The result has often been a long series of conferences with a program directed toward better health of which corrected weight was one index. By the revised procedure a few more students will be told they are markedly underweight, a few less that they are notably overweight, but that change seems desirable from the standpoint of those who know best what student health means. The method is therefore presented as one useful for college women and probably also for those up to at least 30 years of age.

## REGRESSION EQUATION

The original measurements of our group of 241 were also considered from another point of view, the method of averages. This may be defensible in view of the character of the group, obviously healthy as a whole and known to have had exceptional care through childhood and youth. Miss Kimball derived from the measurements used for the Willoughby-Turner method a regression equation which gives for each student the *average* weight of those of her build as shown by the measurements used. The equation is as follows:

$$x_0 = .25x_1 + 6.29x_2 + 3.14x_3 + 4.89x_4 + 7.25x_5 + 11.85x_6 - 179.02$$

$x_0$ = calculated normal weight in pounds
$x_1$ = height
$x_2$ = chest width
$x_3$ = bi-iliac width
$x_4$ = bitrochanteric width

$x_5$ = wrist girth (average of right and left)
$x_6$ = ankle girth (average of right and left)
All measurements are recorded in inches and tenths.

Weights have been calculated by this equation for the 241 students entering in 1941. Table 8 includes the usual statistical determinations for the weights predicted by the regression equation as well as the simple and multiple correlation coefficients obtained for these weights with the various original measurements. Table 9 gives arithmetic averages for these weights as compared with the other averages already derived. The somewhat higher average by the method of the regression equation is doubtless the expression of what seems to us a slight but persistent tendency to overweight in the group as a whole. The use of this method is suggested for those observers to whom the preferred method is based on averages obtained from a group of suitable size.

## SIZE OF SAMPLE

The size of a satisfactory sample is a matter of importance. Our samples during the 6-year period were as follows: 244, 249, 306, 278, 237, 298. The results were kept separate for many trial calculations and were reasonably close together though not identical. That smaller numbers, 100 or less, frequently used in studies of this kind are not large enough is attested by the figures for the first and second samples of 100 each and the remaining 41 cases obtained from our group of 241. They were segregated during the calculations for the Willoughby-Turner and Regression Equation methods with the results shown below. The order of students' cards was alphabetical. These averages are arithmetic.

| | *Total average 241 cases* | *First 100 cases* | *Second 100 cases* | *Remaining 41 cases* |
|---|---|---|---|---|
| Willoughby-Turner Average weight | 124.61 | 123.22 | 126.23 | 124.04 |
| Regression Equation Average weight | 126.59 | 125.56 | 127.91 | 125.92 |

The conclusion from our various data is the belief that a sample of around 250 is in all probability adequate.

## COMPARISON WITH OTHER METHODS

A critical study of the Willoughby system naturally includes its comparison with other procedures. Calculations were made by several methods from the measurements of a chance sample of our students, those whose names begin with A or B in our group of 241. This sample of 36 is small but it is not used as a standard group and all individuals were subjected to the same procedures. Individuals of widely varying weights and builds are included. The results are shown in Table 10. Actual weights and the three weights calculated by our procedures all average for this sample somewhat less than for

the total group. This should be borne in mind in estimating the results for the other methods which all might be expected to run somewhat higher in the group of 241.

The Medico-Actuarial (1912) results are based on height, age, and sex only. See also Sherman (1941) for a recent statement. It will be noted that these tables yield not only the highest average for our group but that it is higher than the average of actual weights by a significant amount. Our group (see Appendix 1) is surely as high in weight as any of the healthy groups whose measurements are recorded in the literature. Our opinion that they are somewhat overweight is attested not only by observation of the young women themselves but by the evidence of their posture pictures which are always available for study. This Medico-Actuarial standard therefore seems open to criticism for student populations like ours. See also Shelton (1932 p. 501), for an individual study. A recent pamphlet issued by the Life Extension Examiners (1942) gives three weights for each height, for medium build, slender build, and large frame. The medium figures run as high as those of the Medico-Actuarial tables up to age 30, after which "weight should remain fixed." No guidance is given for determining types of build.

The Pryor system (1940) like all others includes age and sex, a fact which will not be noted again. The measurements are total height, bi-iliac width, and chest width. The average is in the higher group, with a high level for the smaller individuals as a notable characteristic. The tables provided for ready computation sacrifice mathematical accuracy to ease of use with unfortunate irregularities as a result.

Boillin (1930) presents an excellent regression equation for her Group E made up of 815 Wellesley students, with height; chest depth; and biacromial, chest, and hip widths the measurements of choice. Her equation is this:

Expected Weight (kilos) = 1.137 Hip Width + .2384 Height + 2.092 Chest Depth + .407 Biacromial Width + 1.302 Chest Width — 95.1025.

All dimensions are in centimeters. A form of equation with English units is also given. The relative force of her five measurements as used in weight predictions by this equation is shown by the accompanying list, all figures percentages.

| | |
|---|---|
| Height | 16 |
| Width of Hips | 20 |
| Chest Depth | 32 |
| Width of Shoulders | 9 |
| Width of Chest | 23 |

She finds the biacromial width low in value relatively, as do we. In comparing the measurements used in Boillin's study with ours, it

should be noted that three of her five are of the thoracic region whereas there is no representation of the appendages nor any effort to ascertain the calibre of the limb bones by girth figures as in Willoughby's series. While her correlation coefficient for the five measurements with actual weight, .8286, is slightly higher than ours by the Willoughby-Turner method, .8195, it seems possible that this is due rather to a somewhat repetitive use of thoracic measurements than to the addition of other representative skeletal values.

Recent studies made by several workers at Wellesley College are based on 1560 cases collected from 17 colleges and include comparative computations on a group of 101 cases. (Powell, 1940; Ludlum and Powell, 1940; Bell, 1941) The method chosen is the use of a regression equation based on height in inches, chest depth and chest width in centimeters. Their multiple correlation coefficient with actual weight is .772 materially lower than those of Boillin or Mount Holyoke. Tables are given for the rapid determination of body weight by this equation, with a somewhat opportunistic derivation.

Weight = 2.6 × sum of measurements (in units given above) — 154.3. It is to be noted that skeletal representation is limited. The results with our group of 36 students by this method give an average distinctly below that obtained by any method thus far mentioned except the original Willoughby procedure which as previously stated seemed open to criticism on this ground.

Bell's master's thesis, as yet unpublished, computed weights for 101 Wellesley students by the methods of Pryor, Medico-Actuarial Medical Directors, Ludlum, McCloy, and Boillin. Her conclusions emphasize the disagreement of the methods, criticize the high level of Pryor's results, and support the Ludlum procedure. The results are not altogether in harmony with ours.

The extensive work of McCloy (1936 and 1938), largely on growing children though adults are included, involves measurements of height, chest circumference, hip width, and knee width. The chest and hip measurements are corrected for the thickness of the fat layer. His multiple correlation coefficient for an 18-year-old group of 214 girls, that most closely related to ours, is very high, .9275. His discussion of the choice of measurements is helpful and also the consideration of skeletal covering by fat and muscle. The regression equation with fat corrections previously made on the two measurements mentioned above is for predicted weight in 18-year-old girls as follows, in kilograms and centimeters (1938, p. 39):

Weight = .3165 height + .6508 hips + .804 Chest circumference + 3.6080 Knee width — 105.23

We have not been able to calculate our group by McCloy's formula because both measurements and technique differ. It has not

seemed to us possible to take accurate measurements of chest circumference at any level because of the interference of mammary tissue. We have not made the fat measurements on our group systematically. They are difficult to take and we seemed to find considerable variation in the tightness of connective tissue and in the firmness of subcutaneous fat. The tables compiled by McCloy do much to simplify the manipulation of measurements, notably those for the fat corrections. For younger subjects than our students his may well be the method of choice. The mammary glands would then not interfere and the status of subcutaneous layers may be more uniform.

Dearborn and Rothney (1940, with references to previous publications) report an extensive series of measurements by the Harvard Growth Study. Their weight investigations lead to a regression equation (p. 303) as follows:

Weight (kilos) = 1.73 Chest Depth + 2.11 Chest Width + 0.28 Standing Height + 1.60 Iliac — 118.4 (all in centimeters)

This is applied to groups of 50 boys and 50 girls aged 14, 15, 16, 17, and to 25 boys and 25 girls aged 18. We have applied their equation to our college group only slightly older than their uppermost category, but with results far from satisfactory. Their panel of measurements applied to our 1941 group of 241 students gave a correlation coefficient of only .7723, materially lower than Boillin's or our own. Very low predicted weights were frequent. There is no representation of the appendages in their measurements.

This comparative study on the whole leads us to the conclusion that the Willoughby-Turner panel of measurements warrants recommendation in view of its biological soundness and the correlations found. These measurements may be used to calculate what seems to us especially to be desired, an optimal weight, by the Willoughby-Turner procedure, or by a regression equation may be used to give a predicted weight closely related to the actual weight of average groups of freshman college women.

## SUMMARY AND CONCLUSIONS

1. A study was made of the weights of 1612 Mount Holyoke College students entering in 1933-1938 inclusive. Optimal weights were obtained by the Willoughby system from total height; widths at biacromial, bi-iliac, and bitrochanteric levels; and girths of wrists, knees, and ankles. The original table for wrist girths was slightly altered. Statistical data are given.

2. A more critical study was made of 241 students entering in 1941. Optimal weights were obtained as above and also by a modified procedure called the Willoughby-Turner method in which knee girths are omitted, chest width is substituted for biacromial width, and all tables are adjusted to the measurements of the Mount

Holyoke group which was distinctly larger in numbers than the original control group. The original plan for determining optimal rather than average weight is retained. Statistical data are given.

3. A regression equation is given as an alternative method. This predicts weight from the same panel of measurements, but utilizes the principle of averages as probably nearly correct for this group.

4. Comparative studies show the differences between these and several other methods of weight prediction.

5. This study concerns young women only. Its results are probably applicable to ages 17-30, though determinations beyond the average age (18-19) of our students are few.

## APPENDIX 1

### Physical Measurements of College Women

To show the placing of our group among other groups recently measured and reported Table 11 has been made. Our college history like that of other institutions shows an upward trend through the years in both weight and height. Data regarding many somewhat earlier series may be found in the bibliography of Donelson *et al* (1940) and in the work of Diehl (1933). Southern institutions seem to show a somewhat shorter and lighter group of women than those from other parts of the country. Our students are among the tallest and heaviest reported.

## APPENDIX 2

### Procedures for Taking Measurements and for Calculating Optimal Weights by the Willoughby-Turner Method

English weights and measures are used since they are more readily visualized by the young women and the general public concerned.

*Apparatus needed.*—All should be checked for accuracy at suitable intervals.

1. Scales to weigh accurately to half pounds or to pounds and tenths.

2. A vertical wall scale for measuring stature, graduated in inches and tenths, with a sliding arm to rest at right angles on the head.

3. Curved metal calipers or sliding wooden calipers with short right-angled pieces at the ends of the arms, for measuring chest width. Graduated in inches and tenths.

4. Sliding wooden calipers with straight ends for measuring bi-iliac and bitrochanteric widths, graduated in inches and tenths.

5. Measuring tapes accurately graduated in inches and tenths. Firm cloth tapes have been found better than metal tapes in that they fit more snugly around wrists and ankles. The cloth tapes are, however, gradually affected by perspiration and must be frequently checked and replaced as needed. At least three tapes have been needed for about 300 examinations.

*Recording.*—A copy of the record card which has been found convenient is shown in Figure 1. Library cards 5 x 8 inches of good stock, ruled with 18 lines, are suitable. Our ruling is placed on the plain side by mimeograph.

Names are typed on the cards before measuring begins to insure correct spelling. Our fall group of 275-325 includes freshmen and a few students entering advanced classes. A secretary is necessary if measuring is to go smoothly and rapidly. Figures are dictated to her in inches and tenths by the observer, she reads them back, and they are checked before the measuring apparatus is removed.

Under "Nationality" on the card our record is only approximately correct. If the student's parents have been born in the United States and are of

Name B.S.H. Class 1946

Date of Birth 4 - 20 - 25 Nationality All American

| Date of Exam. | Weight, lbs. | Height, in. | Age | Chest Width | Bi-iliac Width | Bitrochan. Width | Wrist Girth, right | Wrist Girth, left | Ankle Girth, right | Ankle Girth, left | Equivalent Ankle Girth | Optimal Weight Will.-Turner | Variation fr. B-T lbs. and % | Predicted Weight Regression Equa. | Variation fr. R-E lbs. and % | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9-17-42 | 112.0 | 63.6 | 17-6 | 8.9 | 9.9 | 11.9 | * 5.9 | 5.1 | 7.8 | 7.8 | 7.43 | 107.0 | +4.5% +5.0 | 110.5 | +1.0% +1.5 | |
| | | | | | | | | | | | | | | | | |
| A.B.L. 9-19-42 | 112.0 | 63.6 | 17-4 | 9.7 | 11.5 | 13.2 | 5.8 | 5.7 | 8.2 | 8.1 | 8.21 | 130.0 | -14.% -18.0 | 135.5 | -17.% -23.5 | |

Remarks 9-17-42 B.S.H. Looks slender. About right weight. *Do not use - sprain.
9-19-42 A.B.L. Much too thin.

Figure 1. Record card for Willoughby-Turner Optimal Weight determination. Initials chosen at random, measurements real. A second student's record is shown on this card for comparison. Students are of same height and actual weight, but of differing measurements. See below B. S. H. and A. B. L. computations which in our files are kept on the backs of the cards.

our usual stocks, i. e. from Canada, the British Isles, Scandinavia, Germany, France, Spain, Italy, Switzerland, Mexico or South America, the student is entered as "All American," with the ancestral stocks indicated if recently arrived in this country. Many students have surprisingly little knowledge about the birthplace of grandparents and preceding generations. Students who themselves or whose parents belong by birth and racially in the Orient, the Near East, Russia, or other Slavic countries, or who are of Negro, American Indian or other unusual racial groups, in whole or part, are measured but their records are excluded from statistical studies. Their variations however are not large enough to make their weight calculations unreliable from the health point of view. Records are also excluded from statistical studies if the students have had crippling diseases, with infantile paralysis our most frequent cause. Records of students under correction for abnormal weights with associated conditions of poor health are also excluded. Glandular cases are not infrequent.

In the space at the bottom of the card notes are made as to crippling diseases and other pertinent matters such as obvious fatness and thinness, excellence of proportions, and the like.

If one wrist or ankle differs from the other by .2 inch or more the student is asked about recent sprains or other injuries. Records which are apparently not normal are starred, with a footnote to indicate exclusion from both personal calculations and statistical study. If there is no history of injury unlike wrists and ankles are entered and used as found.

*Measuring Procedure.*—The student comes to the observer in the usual physical education measuring robe, with socks and shoes. Shoes are removed for all measuring, socks and robe only as necessary. The robe is convenient in that it is so easily removed or pushed aside in various regions. Socks are pushed down for ankle girths.

a. *Weight and total height.*—These are determined by the usual physical education techniques. For height the subject stands with heels together, feet straight, body and head erect. Heels, buttocks, shoulders, and head make contact with the measuring scale. Position is checked. The slider is pushed down to rest on the head firmly enough to compress the hair. The weight is taken nude.

b. *Chest Width.*—For this and hip widths the student stands in her "best position." In our practice these measurements are preceded almost immediately by the taking of posture pictures, both habitual and best, a helpful introduction to the measuring for optimal weight. Heels are together, feet straight ahead, body erect. For chest width the curved calipers are held horizontally and applied from the front to the axillae so that each end rests on a rib, presumably the sixth, with pressure light enough not to interfere with respiration. In even fat subjects it is possible to approach this rib with some closeness. The points for the ends of the calipers are palpated in this and succeeding measurements as the apparatus is put into place. The calipers are held as steadily as possible while their fluctuations are watched through three or four breaths. The mid-value is recorded. If the student does not seem to be breathing normally an attempt is made to induce this. Usually nothing is said about breathing as it seems more normal if unconscious.

Before taking the other measurements the student steps up on a 12-inch gymnasium bench as this brings calipers and tape into better position for the observer. She faces the observer. Her position is checked.

c. *Bi-iliac Width.*—This is the width most accurately taken. The sliding calipers are held horizontally and applied firmly to the widest point of the iliac crests, with care that there be no slipping over the lip or down the side of the bone. In the case of fat students a preliminary remark warns them that they will be pinched, to secure a reading as nearly skeletal as possible. Fat can be pushed aside to a considerable extent if pressure is applied gradually.

d. *Bitrochanteric Width.*—The greater trochanters come nearest the surface at the greatest hip width, approximately. They can usually be found easily by palpation. A rotating movement of the leg may help to locate the trochanter in a doubtful case, after which the student's position must be checked again. Sliding calipers held horizontally are applied firmly.

e. *Wrist Girth.*—Both wrists are measured. The hand is held out to the observer with the elbow moderately flexed, the back of the hand uppermost and in line with the arm, the fingers easily spread, not tense. The tape is applied at the line of smallest girth between the styloid processes and the hand where there is a natural groove. Even in fat subjects there is relatively little fat here. The tissue composing this region is largely skeletal in character; bony, ligamentous, and tendinous. The tape is drawn closely. See Willoughby (1942) for an extreme instance where the fat about wrists and ankles is notably less than at the knees.

f. *Ankle Girth.*—The subject often tries to help by extending her foot to the observer. She is told to keep her stance as before, with heels together and the weight evenly divided between the two feet. The level of measurement is that of the smallest ankle girth, above the malleoli. As in the case of the wrist there is usually little fat here. The tape is closely drawn.

*Calculations.*—Convenient, easily read copies of the tables help greatly in speed and accuracy of computation. See Tables 12-16, inclusive. The back of the card is used.

In a vertical series the proportionate ankle girths of all five measurements not including height are recorded, with the two wrist and ankle

measurements averaged to give a single figure for each. The narrow ruling of our cards helps to keep the work orderly. The figures are added and divided by 5. The result is the "Ankle Equivalent," which represents the size of the skeleton. A weight factor is found for this from Table 16. This is according to Willoughby the weight in pounds of one vertical inch of a cylinder equivalent in height and optimal weight to the body whose skeletal measurements are under consideration. This factor is multiplied by the height in inches. The result is the optimal weight of the subject. It is recorded to the nearest half pound. All computations are checked. Two examples are shown in Figure 1, affording an interesting comparison which brings out the significance of difference in widths and girths though height and weight may be alike. The computations for these cases are given below.

| Calculations for B. S. H. | Calculations for A. B. L. |
|---|---|
| 7.32 ankle/ chest width. Table 12 | 7.97 |
| 7.13 ankle/ bi-iliac. Table 13 | 8.28 |
| 7.50 ankle/ bitrochan. Table 14 | 8.31 |
| 7.38 ankle/ wrist. Table 15 | 8.32 |
| 7.80 ankle | 8.15 |
| 37.13 ÷ 5 = 7.43 ankle equivalent | 41.03 ÷ 5 = 8.21 |
| 1.681 weight factor for 7.43. Tab. 16 | 2.046 weight factor for 8.21 |
| 1.681 x 63.6 = 107 *optimal weight* | 2.046 x 63.6 = 130 *optimal weight* |

Student B. S. H. is slender in all measurements and is overweight by a negligible amount. Student A. B. L. because of her much broader frame is markedly underweight and would be urged to come in for special conferences.

It has been our custom to send each student a note stating her actual and her optimal weights and indicating to her the desirability of a conference with the Medical Department if her actual weight is more than 7 per cent below or 15 per cent above the optimal. We now use 8 per cent and 12 per cent with the change in tables. Corrective programs are planned after the cases have been studied.

The whole purpose of the measuring and accompanying study is, of course, getting the students to a state of optimal health of which weight is one indication. The method has been found helpful in our experience.

## APPENDIX 3

### Prediction of Body Weight for Young Women by a Regression Equation

As stated in the text, the aim of this method is to predict as nearly as possible the weight actually found to be the average weight of young women having the measurements observed. It therefore may and usually does differ from the optimal weight found according to Appendix 2. Since our young women are for the most part in normal health with few individuals very thin or very fat, the results of the two methods are however not far apart. Some workers may prefer this procedure.

The equation has been calculated from the same measurement used in the study of optimal weights since this panel seems to us defensible. It follows:

$$x_0 = .23x_1 + 6.29x_3 + 3.14x_3 + 4.89x_4 + 7.25x_5 + 11.85x_6 - 179.02$$

The equivalence of terms in this equation is given below.

$x_0$ = calculated normal weight in pounds
$x_1$ = height in inches and tenths
$x_3$ = chest width
$x_3$ = bi-iliac width
$x_4$ = bitrochantric width
$x_5$ = wrist girth (average of right and left)
$x_6$ = ankle girth (average of right and left)

The result is recorded in pounds and half pounds.

The necessary multiplications may be done by calculating machine, slide rule, or most conveniently, if large numbers of students are involved, by the use of tables. These are made by determining the values for the smallest and largest measurements of the group and arranging between these terminal values the equivalents for all possible measurements. Looking up the figures for addition according to the equation then becomes a simple matter. Such a set of tables may be obtained by writing to the author. Two examples of computations are given below, using the students whose measurements are recorded in Figure 1.

| Computations for B. S. H. | Computations for A. B. L. |
|---|---|
| 14.62 (.23 x height) | 14.62 |
| 55.98 (6.29 x chest width) | 61.01 |
| 31.08 (3.14 x bi-iliac width) | 36.11 |
| 58.20 (4.89 x bitrochanteric) | 64.56 |
| 36.97 (7.25 x wrist girth) | 41.68 |
| 92.43 (11.85 x ankle girth) | 96.57 |
| 289.28 — 179.02 = 110.5 Weight predicted by Regression Equation | 314.55 — 179.02 = 135.5 Weight predicted by Regression Equation |

The weights predicted by this method are in the majority of cases, as in these instances, somewhat higher than the Willoughby-Turner weights.

## APPENDIX 4

### 1942 Entrants—Statistical Determinations and Optimal Weights

Measurements were made as described in Appendix 2 on the 1942 entrants, 268 in number, after the usual omissions. They were studied statistically. The summary of the findings is given in Table 17. The simple and multiple correlation coefficients for the measurements as used in the Willoughby-Turner method with both actual and optimal weights are given in Table 18. It will be noted that though there are variations in detail from the 1941 group they are not extensive and the multiple correlation coefficients for the two years are near together. The 1942 group is slightly shorter and lighter in weight.

TABLE 1

Statistical Determinations on 1612 Entering Women Students, Mount Holyoke College, 1933 to 1938 Inclusive. Optimal Weight by Willoughby Method, Modified for Wrist Size. In Pounds and Inches.*

| | Mean | Standard Deviation | Coefficient of Variation in Per Cent |
|---|---|---|---|
| Actual Weight | 126.23 | 16.54 | 13.01 |
| Optimal Weight | 122.61 | 13.07 | 10.66 |
| Height | 64.76 | 2.32 | 3.61 |
| Biacromial Width | 13.50 | .71 | 5.28 |
| Bi-iliac Width | 11.05 | .60 | 5.41 |
| Bitrochanteric Width | 12.57 | .62 | 4.94 |
| Wrist Girth | 5.55 | .27 | 4.84 |
| Knee Girth | 13.75 | .82 | 5.94 |
| Ankle Girth | 8.02 | .46 | 5.76 |

* These determinations were made from frequency distributions. The arithmetical means are usually slightly lower.

TABLE 2

SIMPLE AND MULTIPLE CORRELATION COEFFICIENTS FOR ACTUAL WEIGHT AND FOR OPTIMAL WEIGHT BY THE WILLOUGHBY METHOD WITH SEVEN MEASUREMENTS. 1612 ENTERING WOMEN STUDENTS.

| | Actual Weight (0) | Optimal Weight (0a) | Height (1) | Biacromial Width (2) | Bi-iliac Width (3) | Bitrochanteric Width (4) | Wrist Girth (5) | Knee Girth (6) | Ankle Girth (7) |
|---|---|---|---|---|---|---|---|---|---|
| (1) Height | .4636 | .6943 | 1 | | | | | | |
| (2) Biacromial Width | .4518 | .5534 | .4064 | 1 | | | | | |
| (3) Bi-iliac Width | .6143 | .6990 | .4411 | .3555 | 1 | | | | |
| (4) Bitrochanteric Width | .6984 | .7041 | .4319 | .3403 | .6567 | 1 | | | |
| (5) Wrist Girth | .5191 | .6394 | .3648 | .3672 | .3742 | .3459 | 1 | | |
| (6) Knee Girth | .8108 | .7368 | .3376 | .3230 | .5124 | .6004 | .5221 | 1 | |
| (7) Ankle Girth | .6194 | .6679 | .2929 | .3053 | .3909 | .4292 | .6615 | .6904 | 1 |

Multiple Correlation Coefficient for actual weight with seven other measurements, Kelley method, .876; Doolittle method, .8758.

Multiple Correlation Coefficient for optimal weight with same measurements, Kelley method, .941; Doolittle method, .9419.

TABLE 3

STATISTICAL DETERMINATIONS ON 241 ENTERING WOMEN STUDENTS. MOUNT HOLYOKE COLLEGE, 1941. OPTIMAL WEIGHT BY WILLOUGHBY METHOD, MODIFIED FOR WRIST SIZE. IN POUNDS AND INCHES.*

| | Mean | Standard Deviation | Probable Error | Coefficient of Variation in Per Cent |
|---|---|---|---|---|
| Actual Weight | 127.99 | 14.12 | 9.52 | 11.03 |
| Optimal Weight | 123.05 | 11.91 | 8.03 | 9.68 |
| Height | 65.05 | 2.23 | 1.50 | 3.43 |
| Biacromial Width | 13.47 | .63 | .43 | 4.68 |
| Bi-iliac Width | 11.11 | .55 | .37 | 4.95 |
| Bitrochanteric Width | 12.76 | .58 | .39 | 4.55 |
| Wrist Girth | 5.46 | .24 | .16 | 4.36 |
| Knee Girth | 13.69 | .73 | .49 | 5.30 |
| Ankle Girth | 7.93 | .43 | .29 | 5.38 |

* See note to Table 1. See also Table 8.

TABLE 4

SIMPLE AND MULTIPLE CORRELATION COEFFICIENTS FOR ACTUAL WEIGHT AND FOR OPTIMAL WEIGHT BY THE WILLOUGHBY METHOD WITH SEVEN MEASUREMENTS. 241 ENTERING WOMEN STUDENTS.

| | Actual Weight (0) | Optimal Weight (0a) | Height (1) | Biacromial Width (2) | Bi-iliac Width (3) | Bitrochanteric Width (4) | Wrist Girth (5) | Knee Girth (6) | Ankle Girth (7) |
|---|---|---|---|---|---|---|---|---|---|
| (1) Height | .4053 | .6936 | 1 | | | | | | |
| (2) Biacromial Width | .4706 | .5355 | .3801 | 1 | | | | | |
| (3) Bi-iliac Width | .5921 | .7105 | .4523 | .3227 | 1 | | | | |
| (4) Bitrochanteric Width | .6510 | .7353 | .3988 | .3175 | .6992 | 1 | | | |
| (5) Wrist Girth | .6054 | .7192 | .3977 | .3099 | .4262 | .5049 | 1 | | |
| (6) Knee Girth | .8255 | .6920 | .2692 | .3154 | .4406 | .5661 | .5723 | 1 | |
| (7) Ankle Girth | .6997 | .7453 | .3391 | .3017 | .4640 | .5123 | .6462 | .6868 | 1 |

Multiple Correlation Coefficient for actual weight with seven other measurements, Doolittle Method, .8913.

Multiple Correlation Coefficient for optimal weight with same measurements, Doolittle Method, .9612.

TABLE 5

EFFECT OF OMISSION OF KNEE GIRTH ON MULTIPLE CORRELATION COEFFICIENTS

| | |
|---|---|
| Actual Weight / 7 Measurements including Knee Girth, 1612 Students | .8758 |
| Actual Weight / 6 Measurements excluding Knee Girth, 1612 Students | .8142 |
| Actual Weight / 7 Measurements including Knee Girth, 241 Students.... | .8913 |
| Actual Weight / 6 Measurements excluding Knee Girth, 241 Students.... | .8163 |
| Optimal Weight / 7 Measurements including Knee Girth, 1612 Students | .9419 |
| Optimal Weight / 6 Measurements excluding Knee Girth, 1612 Students | .9312 |
| Optimal Weight / 7 Measurements including Knee Girth, 241 Students | .9612 |
| Optimal Weight / 6 Measurements excluding Knee Girth, 241 Students | .9605 |

TABLE 6

STATISTICAL DETERMINATIONS ON CHEST MEASUREMENTS OF 241 ENTERING WOMEN STUDENTS, 1941

| | *Mean* | *Standard Deviation* | *Probable Error* | *Coefficient of Variation* | *Correlation with Actual Weight* |
|---|---|---|---|---|---|
| Chest Depth | 6.51 | .52 | .35 | 8.02 | .4967 |
| Chest Width | 9.74 | .51 | .34 | 5.22 | .5684 |
| Chest Girth | 32.82 | 1.53 | 1.03 | 4.66 | .7632 |

TABLE 7

SIMPLE AND MULTIPLE CORRELATION COEFFICIENTS FOR ACTUAL WEIGHT AND FOR OPTIMAL WEIGHT WITH SIX MEASUREMENTS. CHEST WIDTH SUBSTITUTED FOR BIACROMIAL WIDTH AND CALCULATION OF OPTIMAL WEIGHT MADE BY WILLOUGHBY-TURNER TABLES. STATISTICAL DETERMINATIONS ON OPTIMAL WEIGHT. 241 ENTERING WOMEN STUDENTS.

| | *Actual Weight* (0) | *Optimal Weight* (0a) | *Height* (1) | *Chest Width* (2) | *Bi-iliac Width* (3) | *Bitrochanteric Width* (4) | *Wrist Girth* (5) | *Ankle Girth* (6) |
|---|---|---|---|---|---|---|---|---|
| (1) Height | .4053 | .6865 | 1 | | | | | |
| (2) Chest Width | .5684 | .6291 | .2793 | 1 | | | | |
| (3) Bi-iliac Width | .5921 | .7428 | .4523 | .4163 | 1 | | | |
| (4) Bitrochanteric Width | .6510 | .7622 | .3988 | .4616 | .6992 | 1 | | |
| (5) Wrist Girth | .6054 | .7072 | .3977 | .3688 | .4262 | .5049 | 1 | |
| (6) Ankle Girth | .6997 | .7142 | .3391 | .3955 | .4640 | .5123 | .6462 | 1 |

Multiple Correlation Coefficient for Actual Weight and Six Other Measurements, Doolittle Method, .8195.

Multiple Correlation Coefficient for Optimal Weight and same Measurements, Doolittle Method, .9638.

Statistical Determinations for Optimal Weights obtained by Willoughby-Turner Method. 241 Students.

| | | | |
|---|---|---|---|
| Mean of Optimal Weights | 124.92 | Probable Error | 8.15 |
| Standard Deviation | 12.09 | Coefficient of Variation | 9.67 |

TABLE 8

STATISTICAL DETERMINATIONS FOR WEIGHTS PREDICTED BY REGRESSION EQUATION AND SIMPLE AND MULTIPLE CORRELATION COEFFICIENTS FOR THESE WEIGHTS WITH THE MEASUREMENTS TAKEN FOR THE WILLOUGHBY-TURNER METHOD. 241 STUDENTS.

| | | | |
|---|---|---|---|
| Mean of Weights predicted by Regression Equation | 126.91 | Probable Error | 8.17 |
| Standard Deviation | 12.11 | Coefficient of Variation | 9.54 |

Simple Correlation Coefficients of Predicted Weight and Six Measurements:

| | | | |
|---|---|---|---|
| Height | .5044 | Bitrochanteric Width | .7807 |
| Chest Width | .6624 | Wrist Girth | .7159 |
| Bi-iliac Width | .6935 | Ankle Girth | .8063 |

Multiple Correlation Coefficient for Predicted Weight with Six Measurements, .9612.

TABLE 9

ARITHMETICAL AVERAGES OF WEIGHTS OF 241 ENTERING WOMEN STUDENTS AS INDICATED. IN POUNDS.

| | |
|---|---|
| Actual Weight | 127.52 |
| Optimal Weight—Willoughbly Method | 122.48 |
| Optimal Weight—Willoughby-Turner | 124.61 |
| Predicted Weight—Regression Equation | 126.59 |

TABLE 10

WEIGHT PREDICTION. COMPARATIVE DATA ON 36 STUDENTS, THE A's AND B's OF THE ALPHABETICALLY ARRANGED 241 ENTERING WOMEN OF TABLE 3, ETC. IN POUNDS.

| *Weights used* | *Average Weight Arithmetical* | *Range of Predicted Weights* |
|---|---|---|
| Actual Weights | 125.5 | 101.0 - 152.0 |
| *Willoughby—Optimal Weights | 120.6 | 98.0 - 135.5 |
| †Willoughby-Turner—Optimal Weights | 122.8 | 102.5 - 139.0 |
| ‡See Text pages 259-60, also Table 8. Predicted Weights | | |
| #Medico-Actuarial—Predicted Weights | 127.3 | 111.0 - 154.0 |
| **Pryor—Predicted Weights | 125.3 | 110.0 - 144.0 |
| ††Boillin—Predicted Weights | 123.8 | 103.0 - 142.0 |
| ‡‡Ludlum—Predicted Weights | 120.3 | 102.5 - 134.5 |
| ##Dearborn-Rothney—Predicted Weights | 116.7 | 88.0 - 139.0 |

* Willoughby Method, as for Tables 2 and 4.
† Willoughby-Turner Method, as for Table 7.
‡ See Text pages 259-60, also Table 8.
# Association of Life Insurance Medical Directors, 1912.
** Pryor, 1940.
†† Boillin, 1930.
‡‡ Ludlum and Powell, 1940.
## Dearborn and Rothney, 1941.

TABLE 11

RECENT PHYSICAL MEASUREMENTS OF ENTERING COLLEGE WOMEN

| | *Year* | *Number of Students* | *Height Inches* | *Cm* | *Weight Pounds* | *Kgm* |
|---|---|---|---|---|---|---|
| *Mount Holyoke College | | | | | | |
| 6 classes | 1933-1938 | 1612 | 64.76 | 164.5 | 126.2 | 57.3 |
| 1 class | 1941 | 241 | 65.05 | 165.1 | 128.0 | 56.1 |
| †Smith College | 1933 | 2485 | 64.25 | 163.2 | 123.5 | 56.3 |
| #Middle States Universities | 1940 | 1013 | 64.41 | 163.6 | 125.7 | 57.2 |

The Mount Holyoke College dates are those of measurement, the others those of publication.

* Mount Holyoke College, present study.
† Smith College, data quoted from Diehl, 1933.
# Data quoted from Donelson, 1940, for Iowa State College, Kansas State College, University of Minnesota, Ohio State University, Oklahoma A. and M. College.

TABLE 12

FOR YOUNG WOMEN. FOR DERIVING PROPORTIONATE ANKLE GIRTH FROM CHEST WIDTH. IN INCHES.

| *Chest Width* | *Ankle Girth* | *Chest Width* | *Ankle Girth* |
|---|---|---|---|
| 8.0 | 6.59 | 10.0 | 8.22 |
| 8.1 | 6.67 | 10.1 | 8.30 |
| 8.2 | 6.75 | 10.2 | 8.38 |
| 8.3 | 6.83 | 10.3 | 8.46 |
| 8.4 | 6.92 | 10.4 | 8.54 |
| 8.5 | 7.00 | 10.5 | 8.62 |
| 8.6 | 7.08 | 10.6 | 8.70 |
| 8.7 | 7.16 | 10.7 | 8.79 |
| 8.8 | 7.24 | 10.8 | 8.87 |
| 8.9 | 7.32 | 10.9 | 8.95 |
| 9.0 | 7.40 | 11.0 | 9.03 |
| 9.1 | 7.49 | 11.1 | 9.11 |
| 9.2 | 7.57 | 11.2 | 9.19 |
| 9.3 | 7.65 | 11.3 | 9.27 |
| 9.4 | 7.73 | 11.4 | 9.35 |
| 9.5 | 7.81 | 11.5 | 9.44 |
| 9.6 | 7.89 | 11.6 | 9.52 |
| 9.7 | 7.97 | 11.7 | 9.60 |
| 9.8 | 8.05 | 11.8 | 9.68 |
| 9.9 | 8.14 | 11.9 | 9.76 |

TABLE 13

FOR YOUNG WOMEN. FOR DERIVING PROPORTIONATE ANKLE GIRTH FROM BI-ILIAC WIDTH. IN INCHES.

| *Bi-iliac Width* | *Ankle Girth* | *Bi-iliac Width* | *Ankle Girth* |
|---|---|---|---|
| 9.1 | 6.56 | 11.2 | 8.07 |
| 9.2 | 6.63 | 11.3 | 8.14 |
| 9.3 | 6.70 | 11.4 | 8.21 |
| 9.4 | 6.77 | 11.5 | 8.28 |
| 9.5 | 6.84 | 11.6 | 8.36 |
| 9.6 | 6.92 | 11.7 | 8.43 |
| 9.7 | 6.99 | 11.8 | 8.50 |
| 9.8 | 7.06 | 11.9 | 8.57 |
| 9.9 | 7.13 | 12.0 | 8.64 |
| 10.0 | 7.20 | 12.1 | 8.72 |
| 10.1 | 7.28 | 12.2 | 8.79 |
| 10.2 | 7.35 | 12.3 | 8.86 |
| 10.3 | 7.42 | 12.4 | 8.93 |
| 10.4 | 7.49 | 12.5 | 9.00 |
| 10.5 | 7.56 | 12.6 | 9.08 |
| 10.6 | 7.64 | 12.7 | 9.15 |
| 10.7 | 7.71 | 12.8 | 9.22 |
| 10.8 | 7.78 | 12.9 | 9.29 |
| 10.9 | 7.85 | 13.0 | 9.36 |
| 11.0 | 7.92 | 13.1 | 9.44 |
| 11.1 | 8.00 | 13.2 | 9.51 |

TABLE 14

FOR YOUNG WOMEN. FOR DERIVING PROPORTIONATE ANKLE GIRTH FROM BITROCHANTERIC WIDTH. IN INCHES.

| *Bitrochanteric Width* | *Ankle Girth* | *Bitrochanteric Width* | *Ankle Girth* |
|---|---|---|---|
| 10.5 | 6.62 | 13.0 | 8.19 |
| 10.6 | 6.69 | 13.1 | 8.25 |
| 10.7 | 6.75 | 13.2 | 8.31 |
| 10.8 | 6.81 | 13.3 | 8.37 |
| 10.9 | 6.87 | 13.4 | 8.44 |
| 11.0 | 6.94 | 13.5 | 8.50 |
| 11.1 | 7.00 | 13.6 | 8.56 |
| 11.2 | 7.06 | 13.7 | 8.62 |
| 11.3 | 7.13 | 13.8 | 8.69 |
| 11.4 | 7.19 | 13.9 | 8.75 |
| 11.5 | 7.25 | 14.0 | 8.81 |
| 11.6 | 7.31 | 14.1 | 8.87 |
| 11.7 | 7.38 | 14.2 | 8.94 |
| 11.8 | 7.44 | 14.3 | 9.00 |
| 11.9 | 7.50 | 14.4 | 9.06 |
| 12.0 | 7.56 | 14.5 | 9.12 |
| 12.1 | 7.63 | 14.6 | 9.19 |
| 12.2 | 7.69 | 14.7 | 9.25 |
| 12.3 | 7.75 | 14.8 | 9.31 |
| 12.4 | 7.81 | 14.9 | 9.37 |
| 12.5 | 7.88 | 15.0 | 9.44 |
| 12.6 | 7.94 | 15.1 | 9.50 |
| 12.7 | 8.00 | 15.2 | 9.56 |
| 12.8 | 8.06 | 15.3 | 9.62 |
| 12.9 | 8.13 | 15.4 | 9.69 |

TABLE 15

FOR YOUNG WOMEN. FOR DERIVING PROPORTIONATE ANKLE GIRTH FROM WRIST GIRTH. IN INCHES.

| *Wrist Girth* | *Ankle Girth* | *Wrist Girth* | *Ankle Girth* |
|---|---|---|---|
| 4.60 | 6.66 | 5.60 | 8.10 |
| 4.65 | 6.74 | 5.65 | 8.18 |
| 4.70 | 6.81 | 5.70 | 8.25 |
| 4.75 | 6.88 | 5.75 | 8.32 |
| 4.80 | 6.95 | 5.80 | 8.39 |
| 4.85 | 7.02 | 5.85 | 8.46 |
| 4.90 | 7.10 | 5.90 | 8.54 |
| 4.95 | 7.17 | 5.95 | 8.61 |
| 5.00 | 7.24 | 6.00 | 8.68 |
| 5.05 | 7.31 | 6.05 | 8.75 |
| 5.10 | 7.38 | 6.10 | 8.82 |
| 5.15 | 7.46 | 6.15 | 8.90 |
| 5.20 | 7.53 | 6.20 | 8.97 |
| 5.25 | 7.60 | 6.25 | 9.04 |
| 5.30 | 7.67 | 6.30 | 9.11 |
| 5.35 | 7.74 | 6.35 | 9.18 |
| 5.40 | 7.82 | 6.40 | 9.26 |
| 5.45 | 7.89 | 6.45 | 9.33 |
| 5.50 | 7.96 | 6.50 | 9.40 |
| 5.55 | 8.03 | 6.55 | 9.47 |

TABLE 16

WEIGHT FACTORS FOR DETERMINING THE OPTIMAL BODY WEIGHT FOR EACH INCH OF HEIGHT FROM EQUIVALENT ANKLE GIRTH DERIVED FROM FIVE MEASUREMENTS. FOR YOUNG WOMEN. IN POUNDS. WITH INTERPOLATION FACTOR FOR EACH .01 INCH GIRTH.

| *Equivalent Ankle Girth* | *Weight Factor* | *Interpolation Factor* | *Equivalent Ankle Girth* | *Weight Factor* | *Interpolation Factor* |
|---|---|---|---|---|---|
| 6.60 | 1.338 | .0038 | 8.10 | 1.992 | .0048 |
| 6.65 | 1.356 | .0040 | 8.15 | 2.016 | .0050 |
| 6.70 | 1.376 | .0040 | 8.20 | 2.041 | .0050 |
| 6.75 | 1.396 | .0040 | 8.25 | 2.066 | .0050 |
| 6.80 | 1.416 | .0040 | 8.30 | 2.091 | .0050 |
| 6.85 | 1.436 | .0040 | 8.35 | 2.116 | .0050 |
| 6.90 | 1.456 | .0040 | 8.40 | 2.141 | .0050 |
| 6.95 | 1.476 | .0042 | 8.45 | 2.166 | .0052 |
| 7.00 | 1.497 | .0042 | 8.50 | 2.192 | .0052 |
| 7.05 | 1.518 | .0042 | 8.55 | 2.218 | .0052 |
| 7.10 | 1.539 | .0042 | 8.60 | 2.244 | .0052 |
| 7.15 | 1.560 | .0042 | 8.65 | 2.270 | .0052 |
| 7.20 | 1.581 | .0042 | 8.70 | 2.296 | .0052 |
| 7.25 | 1.602 | .0044 | 8.75 | 2.322 | .0054 |
| 7.30 | 1.624 | .0044 | 8.80 | 2.349 | .0054 |
| 7.35 | 1.646 | .0044 | 8.85 | 2.376 | .0054 |
| 7.40 | 1.668 | .0044 | 8.90 | 2.403 | .0054 |
| 7.45 | 1.690 | .0044 | 8.95 | 2.430 | .0054 |
| 7.50 | 1.712 | .0044 | 9.00 | 2.457 | .0054 |
| 7.55 | 1.734 | .0046 | 9.05 | 2.484 | .0056 |
| 7.60 | 1.757 | .0046 | 9.10 | 2.512 | .0056 |
| 7.65 | 1.780 | .0046 | 9.15 | 2.540 | .0056 |
| 7.70 | 1.803 | .0046 | 9.20 | 2.568 | .0056 |
| 7.75 | 1.826 | .0046 | 9.25 | 2.596 | .0056 |
| 7.80 | 1.849 | .0046 | 9.30 | 2.624 | .0056 |
| 7.85 | 1.872 | .0048 | 9.35 | 2.652 | .0058 |
| 7.90 | 1.896 | .0048 | 9.40 | 2.681 | .0058 |
| 7.95 | 1.920 | .0048 | 9.45 | 2.710 | .0058 |
| 8.00 | 1.944 | .0048 | 9.50 | 2.739 | .0058 |
| 8.05 | 1.968 | .0048 | 9.55 | 2.768 | .0058 |

TABLE 17

STATISTICAL DETERMINATIONS ON 268 ENTERING WOMEN STUDENTS MOUNT HOLYOKE COLLEGE, 1942. OPTIMAL WEIGHT BY WILLOUGHBY-TURNER METHOD.

| | Mean | Standard Deviation | Probable Error | Coefficient of Variation |
|---|---|---|---|---|
| Actual Weight | 125.34 | 13.42 | 9.05 | 10.71 |
| Optimal Weight | 122.46 | 11.83 | 7.98 | 9.66 |
| Height | 64.91 | 2.38 | 1.60 | 3.66 |
| Chest Width | 9.73 | .47 | .32 | 4.82 |
| Bi-iliac Width | 11.02 | .58 | .39 | 5.25 |
| Bitrochanteric Width | 12.72 | .55 | .37 | 4.31 |
| Wrist Girth | 5.37 | .23 | .15 | 4.21 |
| Ankle Girth | 7.85 | .41 | .28 | 5.20 |

TABLE 18

SIMPLE AND MULTIPLE CORRELATION COEFFICIENTS FOR ACTUAL WEIGHT AND OPTIMAL WEIGHT BY THE WILLOUGHBY-TURNER METHOD. 268 ENTERING STUDENTS, FALL, 1942.

| | Actual Weight (0) | Optimal Weight $O\sigma$ | Height (1) | Chest Width (2) | Bi-iliac Width (3) | Bitrochanteric Width (4) | Wrist Girth (5) | Ankle Girth (6) |
|---|---|---|---|---|---|---|---|---|
| (1) Height | .5074 | .7678 | 1 | | | | | |
| (2) Chest Width | .5567 | .6181 | .4241 | 1 | | | | |
| (3) Bi-iliac Width | .5480 | .7046 | .4429 | .3705 | 1 | | | |
| (4) Bitrochanteric Width | .6842 | .7505 | .5060 | .4419 | .6844 | 1 | | |
| (5) Wrist Girth | .5622 | .6677 | .4106 | .3498 | .4247 | .4600 | 1 | |
| (6) Ankle Girth | .6335 | .6561 | .3655 | .3448 | .3368 | .4626 | .6588 | 1 |

Multiple Correlation Coefficient for Actual Weight with Six Measurements, Doolittle Method, .8115.
Multiple Correlation Coefficient for Optimal Weight with Same Measurements, Doolittle Method, .9564.

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Bell, Margaret O., "A Comparison of Five Methods Designed to Predict the 'Normal' Weight of College Women," Master's Thesis, Wellesley College, 1941, unpublished.

Boillin, M. L., "Determination of the Interrelations, Partial and Multiple, between Various Anthropometric Measurements of College Women," *Contributions to Education*, No. 450, Bureau of Publications, Teachers College, Columbia University, 1930, New York.

Dearborn, W. F., and J. W. M. Rothney, *Predicting the Child's Development* (Cambridge, Mass.: Sci-Art Publishers, 1941).

Diehl, H. S., "The Heights and Weights of American College Women," *Human Biology* 5, 1933, 600-628.

Donelson, E. G., M. A. Ohlson, B. Kennerth, M. B. Patton, and G. M. Kinsman, "Anthropometric Data on College Women of the Middle States," *Amer. Jour. Phys. Anthrop.*, 27, 1940, 319-332.

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Ludlum, F. E., and E. Powell, "Chest-Height-Weight Tables for College Women," *Res. Quar.*, 11, No. 3 (Oct., 1940), 55-57.

McCloy, C. H., "Appraising Physical Status: The Selection of Measurements," *Univ. Iowa Studies. Studies in Child Welfare*, 12, No. 2, 1936.

McCloy, C. H., "Appraising Physical Status: Methods and Norms," *Univ. Iowa Studies. Studies in Child Welfare*, 15, No. 2, 1938.

Powell, E., "The Present Status of Physical Indices," *Res. Quar.*, 11, No. 2 (May, 1940) 2-17.

Pryor, H. B., *Width-Weight Tables for Boys and Girls, from* 1 *to* 17 *years—For Men and Women from* 18 *to* 41+ Years. (Stanford University, Cal.: Stanford University Press, 1940).

Shelton, E. K., "Optimal Weight Estimation. The Method of Willoughby," *Endocrinology*, 16, 1932, 492-505.

Sherman, H. C., *Chemistry of Food and Nutrition*, 6th ed. (New York: The Macmillan Co., 1941).

Willoughby, D. P., "An Anthropometric Method for arriving at the Optimal Proportions of the Body in any Adult Individual," *Res. Quar.*, 3, No. 3 (Oct., 1932) 48-77.

Willoughby, D. P., "An Extraordinary Case of Obesity and a Review of some Lesser Cases," *Human Biol.* 14, 1942, 166-177.

# A Classified List of Current Periodicals in the Fields of Athletics, Health, Physical Education, and Sports Published in the United States and Canada

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## AQUATICS

### BOATING, CANOEING, YACHTING

*Boat club news*, 1926, m.* $2. Cliff Warner, Publisher, 610 Murphy Bldg., Detroit, Mich.

*Boating magazine*. 1926. m. $2. Hugh C. MacLean Publications, Ltd., 2118 Bleury St., Montreal, Quebec.

*Grosse pointer*. 1939. m. Cliff Warner, Publisher, 610 Murphy Bldg., Detroit, Mich.

*Main sheet*. 1939. m. Cliff Warner, Publisher, 610 Murphy Bldg., Detroit, Mich.

*Mid-West yachting news*. 1935. m. $1.50. Walter X. Brennan, 955 E. Jefferson Ave., Detroit, Mich.

*Motor boating combined with Power boating*. 1904. m. $1. Motor Boat Publications, Inc., 63 Beekman St., New York, N. Y. Illus. Indexed: Br. Subj. Ind.

*Motor boating*. 1907. m. $3. Hearst Magazines, Inc., 572 Madison Ave., New York, N. Y. Illus. Indexed: Eng. Ind.

*Motor boating*. Annual supplement. 1907. a. $3. Hearst Publications, Inc., 572 Madison Ave., New York, N. Y. Illus. Indexed: Eng. Ind.

*Pacific motor boat*. 1908. 13 times a year. $3. Miller Freeman Publications, 71 Columbia St., Seattle, Wash. Illus.

*Pacific sportsman*. 1925. m. $1.50. McDonald Publishing Co., 580 Market St., San Francisco, Calif.

*Rudder*. 1890. m. $3. Rudder Publishing Co., 9 Murray St., New York, N. Y. Bk. Rev. Illus. Indexed: Mag. Subj. Ind.

*Sea; the Pacific coast yachting magazine*. 1937. m. $2.50. Pacific Coast

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**NOTE: Periodicals in the fields of hunting, fishing, horse-racing, motoring, and similar sports have been intentionally omitted from this list. The information given includes title of the periodical, date of founding, frequency of publication, subscription price, publisher's address, and special features such as abstracts, bibliographies, indexes, etc. In a number of cases the information as to date of founding and subscription price is not given. In many such cases, as with publications of state departments of health, the periodical may be obtained gratis. If the periodical is indexed or abstracted, the names of the indexing or abstracting services are given. Pretention neither to completeness nor selectiveness is claimed for this list, but it is hoped that it is sufficiently comprehensive to be of some value to teachers and students in these fields. The miscellaneous section at the end of the list includes a few titles of periodicals in related fields which may be found useful to those who wish to keep up with current information in these fields.**

**In compiling this list (revised, 1943) free use has been made of such aids as Ayer and Son's *American Newspaper Annual and Directory*, 1943; Ulrich, *Periodical Directory*, 1938, and *Periodical Directory, Inter-American Edition*, 1943; various small lists, and the periodicals, *Bulletin of Bibliography, Bulletin of the New York Public Library, Monthly Checklist of State Publications*, and *The Writer*.**

*** For all abbreviations refer to appendices at end of article.**

Publications, Inc., 844 Wall St., Los Angeles, Calif. Illus.

*Sea chest; the yachtsman's digest.* 1938. q. $2. Remington Publishing Co., Inc., Box 17, Grand Central Annex, New York, N. Y.

*Yachting.* 1907. m. $4. Yachting Publishing Corporation, 205 East 42nd St., New York, N. Y. Indexed: Mag. Subj. Ind.

DIVING, SWIMMING, NATATORIA

*Beach and pool;* a publication for the development and operation of the nation's pools and beaches. 1927. m. $2. Hoffman-Harris, Inc., 425 Fourth Ave., New York, N. Y. Illus.

*National collegiate athletic association.* Official swimming guide; includes official rules for swimming, fancy diving and water polo. a. 50c. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

*Official aquatic guide.* 1931. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

*Swimming pool data and reference annual.* 1941. a. Hoffman-Harris, Inc., 425 Fourth Ave., New York, N. Y.

*Swimming pool standards.* A. S. Barnes & Co., 67 W. 44th St., New York, N. Y. Indexed: P. H. Eng. Ind.

## ATHLETICS — SPORTS

OUTDOOR ACTIVITIES, GENERAL SPORTS

*Ace.* 1919. m. $1.50. St. Paul Athletic Club, Fourth and Cedar Sts., St. Paul, Minn.

*All-American athlete.* 1940. m. $1.50. All American Athletic Association, 922 Hoe Ave., New York, N. Y.

*All-America sports magazine.* 1933. m. $1.50. Nat Fleisher, Editor, Madison Square Garden Arcade, New York, N. Y.

*Amateur athlete.* 1930. m. $1. Amateur Athletic Union of the United States, 233 Broadway, New York, N. Y.

*Athletic journal;* nation-wide amateur athletics. 1921. m. (Sept.-Je.) $1.50. Athletic Journal Publishing Co., 6858 Glenwood Ave., Chicago, Ill. Illus. Index. Indexed: P. H. Eng. Ind. Q. C. Ind. Med.

*Boys' athletic league.* News letter. m. Boys' Athletic League, New York, N. Y.

*Carteles.* (Spanish) 1919. w. $5.20. Syndicate de Artes Graficas de la Habana, S. A. Avenidas Menocal (Infanta), No. 60, Habana, Cuba.

*Chronicle.* 1936. w. $4. Sunday and Sporting Chronicle, 23a Chacon St., Port of Spain, Trinidad.

*Cleveland athletic club journal.* 1914. m. $1. J. P. Buckley, Editor, and Publisher, 1118 Euclid Ave., Cleveland, Ohio.

*D.A.C. news.* 1916. m. $2.50. ($1 to members), Detroit Athletic Club, 241 Madison Ave., Detroit, Mich. Bk. Rev. Illus.

*D. A. C. news.* 1939. m. Dallas Athletic Club, Athletic Building, Dallas, Texas.

*Empressario internacional.* 1940. Specialized Export Publications, Inc., 220 W. 42nd St., New York, N. Y.

*Harvard athletic association news.* 1927. 9 times a year. $1.50. Harvard Athletic Association, Harvard University, 6 Quincy St., Cambridge, Mass.

*Journal of health and physical education.* 1896. m. (Sept.-Je.) $2.50. American Association for Health, Physical Education, and Recreation, 1201 16th St., N. W., Washington, D. C. Bibl. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Educ. Abstr. Educ. Ind. Q. C. Ind. Med.

*Linterna.* 1925. w. $5. La Linterna, Luna St. 64, San Juan, Puerto Rica.

*Mercury.* 1911. w. $1.50. Los Angeles Athletic Club, 431 W. Seventh St., Los Angeles, Calif.

*N. A. C. club life.* 1921. m. $1. Newark Athletic Club, 16 Park Place, Newark, N. J.

*New York press.* 1924. w. $10. Imperial Publishing Corp., 11 W. 42nd St., New York, N. Y.

*New York state journal of health and physical education and recreation.* Walter A. Cox, Editor, 656 Madison Ave., Albany, N. Y.

*Olympian.* 1900. m. $1. Olympic Club, 524 Post St., San Francisco, Calif.

*Outdoor graphic.* 1942. w. Outdoor Graphic, Inc., Daily News Bldg., 220 E. 42nd St., New York, N. Y.

*Outdoor guide.* 1928. m. (except June and Dec.) $1. Outdoor Guide Publishing Co., 300 Landers Bldg., Springfield, Mo.

*Outdoors.* 1932. m. (except Jan. and May) $1. Outdoor Publications, Inc., 729 Boylston St., Boston, Mass.

*Pennac.* 1923. m. $2. Pennsylvania Athletic Club, Rittenhouse Square, Philadelphia, Pa.

*Police Gazette* (National) 1845. m. $1. H. H. Roswell, Publisher, 1560 Broadway, New York, N. Y.

*Punch.* 1923. m. New Orleans Athletic Club, 222 N. Rampart St., New Orleans, La.

*Recreation.* 1907. m. $2. National Recreation Association, 315 Fourth Ave., New York, N. Y. Bibl. Bk. Rev. Illus. Index. Indexed: P.A.I.S. R. G.

*Salute.* 1934. m. $1. L'Eclaireur de Montreal, Inc., 1725 St. Denis St., Montreal, Quebec.

*Scholastic coach.* 1931. m. (Sept.-Je.) $1.50. Scholastic Corporation, 430 Kinnard Ave., Dayton, Ohio. Bk. Rev. Illus. Index.

*Society pictorial.* 1929. w. (Jan.-Mar.) $2.50. Sunday Pictorial Publishing Co., 1000 Lincoln Road, Miami Beach, Fla.

*Sport;* published in the interest of all forms of amateur athletics. 1916. m. $2. Paul Gibbons, Inc., 506 Race St., Philadelphia, Pa.

*Sport* (French) 1938. w. $2. Sport News, Ltd., 752 Rachel St., E., Montreal, Quebec.

*Sport goods journal of Canada.* 1923. m. $1. Canadian Bicycle and Sport Goods Association, 177 Jarvis St., Toronto, Ont.

*Sporting goods dealer.* 1899. m. $2. Sporting Goods Publishing Co., 217 N. Tenth St., St. Louis, Mo. Illus. Pat. Tr. Lit. Tr. M.

*Sports afield.* 1887. m. $1.50. Sports Afield Publishing Co., Phoenix Bldg., Minneapolis, Minn.

*Sports age.* 1938. m. $3. Andrew Geyer, Inc., 260 Fifth Ave., New York, N. Y.

*Sports illustrated.* 1932. m. $1. Sports Publications of Canada, Inc., Mt. Royal Hotel, Montreal, Quebec.

*Sports review.* 1938. m. (Jan.-Feb. issues combined) $1. Sports Review Publishing Co., 736 Turner St., Allentown, Pa.

*Sportswoman.* 1934. m. (except July-Aug.) $3. The Sportswoman Guild, Inc., 5800 N. Mervine St., Philadelphia, Pa.

*Town and country.* 1846. m. $5. Hearst Magazines, Inc., 572 Madison Ave., New York, N. Y.

*Townsfolk.* 1924. m. $2. Townsfolk Company, 919 N. Michigan Ave., Chicago, Ill.

*Uncle Jake sport news.* 1931. w. $3. Uncle Jake Sport News, 405 Poydras St., Dallas, Texas.

*Winged foot.* 1892. m. $2. New York Athletic Club, 290 Alta Vista Drive, Yonkers, N. Y. Bk. Rev. Illus.

*Winged head.* 1911. m. $1. Pittsburgh Athletic Association, 405 Penn Ave., Pittsburgh, Pa.

### Archery

*American archer.* 1939. q. $1. (Partly free distribution) J. C. Vires, Editor and Publisher, 521 Fifth Ave., New York, N. Y.

*American bowman-review.* 1935. m. $1. Frank Taylor and Son, Albany, Ore.

*National archery association.* Bulletin. 1922. irreg. Price not given. National Archery Association, 77 Franklin St., Boston, Mass.

*Sylvan archer.* 1927. m. $1. National Field Archery Association, 505 N. 11th St., Corvallis, Ore.

### Baseball

*Baseball digest.* 1942. 11 nos. per year. $1.50. 510 North Dearborn St., Chicago.

*Baseball magazine.* 1908. m. $2. Baseball Magazine Co., 175 Fifth Ave., New York, N. Y. Illus.

*Collyer's eye and baseball world.* 1914. w. $7.50. Collyer's Publishing Co., Suite 829, 300 W. Adams St., Chicago, Ill.

*Giants jottings.* 1936. irreg. Free. New York Giants, 104 W. 42nd St., New York N. Y. Illus.

*National league green book.* (National league P.B.B.C.) 1940. 30 Rockefeller Plaza, New York, N. Y.

*Sporting news.* 1886. w. $5. Sporting News Publishing Co., Tenth and Olive Sts., St. Louis, Mo.

*Sporting news;* how to play baseball. 1941. 25c. Charles C. Spink and Sons, Tenth and Olive St., St. Louis, Mo.

*Wind-up, America's baseball annual* 1939. a. S. W. Carlson, 806 4th St., N. E., Minneapolis, Minn.

### Football

*All-American football magazine.* 1938. 2 times per year. 20c per no. 461 Eighth Ave., New York, N. Y. Illus.

*National collegiate athletic association.* Official football guide; includes the official rules. a. 50c. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

*Popular football.* 1941. 60c. Popular Football, 24 W. 48th St., New York, N. Y.

*What's what in football.* 1937. w. $1.50. What's What Publishing Co., 26th and Pratt Sts., Omaha, Nebr.

### Golf

*Canadian golfer.* 1914. m. $3. Canadian Lawn Tennis and Badminton, Ltd., 1434 St. Catherine St., Montreal, Quebec.

*Detroit golfer.* 1939. m. Cliff Warner, 610 Murphy Bldg., Detroit, Mich.

*Golfdom—the business journal of golf.* 1927. m. (except Nov.-Dec.) Controlled free distribution. Golfdom, Inc., 14 E. Jackson Blvd., Chicago, Ill. Illus.

*Greenkeepers' reporter;* devoted to the vital part of golf—maintenance of grounds. 1933. bi-m. $2. Greenkeeping Superintendents Association, St. Charles, Ill.

*Northwest life.* 1927. m. $2 R. L. Forrest, 1220 Hodgson Bldg., Minneapolis, Minn. Bk. Rev. Illus.

*Pacific coast golfer.* 1926. M. (except Jan., Sept.-Nov.) $5. Pacific Coast Golfer, Inc., 112 W. Ninth St., Los Angeles, Calif.

*Professional golfer of America.* 1920? m. $2. Professional Golfers' Association of America, 505 N. Michigan Ave., Chicago, Ill.

### Hockey, LaCrosse

*Lacrosse news.* 1936. q. $1. Lacrosse News, Lutherville, Md.

*National collegiate athletic association.* Official ice hockey guide; includes the official rules. a. 50c. A. S. Barnes & Co., 67 W. 44th St, New York, N. Y.

*National collegiate athletic association.* Official lacrosse guide; includes official rules. a. 50c. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

### Horseshoe Pitching

*Horseshoe world.* 1922. m. $1. Raymond B. Howard, Publisher, 45 West Second St., London, O.

### Motor Cycling—Bicycling

*American bicyclist and motorcyclist.* 1880. m. $2. Cycling Press, Inc., 461 Eight Ave., New York, N. Y.

*Motorcyclist.* 1912. m. $1.25. Western Journal Co., Inc., 1206 S. Maple Ave., Los Angeles, Calif. Illus.

### Soccer

*National collegiate athletic association.* Official soccer guide; includes official rules. a. 50c. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

*Soccer star.* 1928. w. $4. Soccer Star

Publishing Co., 145 Hudson St., New York, N. Y.

### Softball

*Softball magazine.* 1938. m. $1. Softball Magazine, 303 Main St., Stamford, Conn.

### Tennis, Squash, Badminton

*American lawn tennis.* 1907. 15 times a year. $4. American Lawn Tennis, Inc., 500 Fifth Ave., New York, N. Y. Illus.

*Badminton journal.* 1940. 9 nos. per year. $1. 1601 Main St., Evanston, Ill.

*Canadian lawn tennis and North American badminton.* 1920. m. $2. Canadian Lawn Tennis-Badminton, Ltd., 1434 St. Catherine St., W. Montreal, Quebec. Illus.

*Professional tennis.* 1938. m. $1. Professional Tennis, Inc., 321 Broadway, New York, N. Y.

*Sport.* 1916. m. $1.50. Paul Gibbons, Inc., 10 S. 18th St., Philadelphia, Pa.

### Track and Field

*National collegiate athletic association.* Official track and field guide, with official rules. a. 50c. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

### Winter Sports

*Canadian skier.* 1939. m. (Dec.-Mar.) $1. Canadian Amateur Ski Association, 1434 St. Catherine St., W., Montreal, Quebec. Illus.

*Skating.* 1923. 6 times a year. $2. U. S. Figure Skating Association, 30 Huntington Ave., Boston, Mass. Bk. Rev. Illus.

*Ski.* 1937. 7 times a year. $2. 550 74th St., New York, N. Y.

*Ski bulletin.* 1930. m. (Oct.-Dec.) w. (Jan.-Mar.) $1. Alfred B. Morehouse, 27 Beach St., Boston, Mass.

*Ski illustrated.* 1936. 4 times a year. $1 for 5 issues. Your Sport, Inc., 110 E. 42nd St., New York, N. Y.

*Ski news.* 1938. w. (Dec.-Mar.) $1. 1023 Brandywine Ave., Schenectady, N. Y.

## INDOOR ACTIVITIES

### Billiards and Bowling

*Bowler.* 1942. m. $1. Bowler Publishing Co., 110 University Place, New York, N. Y.

*Bowling.* m. American Bowling Congress, 2200 Third St., Milwaukee, Wis.

*Bowling news.* 1938. w. (Sept.-Apr.) $1. Bowling News Co., 256 W. 23rd St., New York, N. Y.

*National bowlers journal and billiards revue.* 1913. m. $2. National Bowlers Journal and Billiard Revue., Inc., 506 S. Wabash Ave., Chicago, Ill.

*Woman bowler.* 1936. m. (bi-m. My.-Je. and Jl.-Aug.) $1. Earl Ward, Editor and Publisher, 608 S. Dearborn St., Chicago, Ill.

### Boxing and Wrestling

*National collegiate athletic association.* Official boxing guide; includes the official rules. a. 50c. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

*National collegiate athletic association.* Official wrestling guide; includes the official rules. a. 50c. A. S. Barnes & Co., 67 W. 44th St., New York, N. Y.

*New international boxing blade.* 1938. s-m. $2. The New Blade Publishing Co., 1536 La Salle St., Chicago, Ill.

*Ring.* 1922. m. $2.50. Ring, Inc., Madison Square Garden, 307 W. 49th St., New York, N. Y.

### Fencing

*Riposte,* by and for fencers of America. 1936. 6 times a year. The Riposte, 114 Washington Place, New York, N. Y. Illus.

## CAMPING

*Camp and trail;* for hikers, skiers, woodsmen. 1941. bi-m. $1. Box 10, Station C, New York, N. Y. Bk. Rev. Illus.

*Camping magazine.* 1930. m. (Oct.-Je.) $2. American Camping Association, Inc., 343 S. Dearborn St., Chicago, Ill. Illus.

*Camping world;* devoted to camp leadership and management. 1935. m. Dec.-Je.) $2. Camping World, Inc., 25 W. 45th St., New York, N. Y.

*National resort and camp journal*—Military and boarding schools. m. 1929. $3. D. L. Mickaelson, 405 W. 23rd St., New York, N. Y.

## DANCING

*Country dancer.* 1940. 4 times a year. 50c. Country Dance Society, Inc., 15 E. 40th St., New York, N. Y. Bk. Rev. Illus.

*Dance,* combined with American dancer. 1927. m. $2.50. Rudor Publishing Co., 250 W. 57th St., New York, N. Y. Bk. Rev. Illus.

*Dance.* 1936. m. (except Aug.-Oct.) $2.50. Dance Forum, Inc., 30 Rockefeller Center, New York, N. Y. Bk. Rev. Illus. Index.

*Dance digest.* 1937. 15c per no. Dance Digest, 505 Fifth Ave., New York, N. Y. Illus.

*Dance educators of America, Inc.* Official bulletin. 10 times a year. Dance Educators of America, Inc., New York, N. Y.

*Dance herald.* 1937. m. (Dec.-Apr.) 50c. American Dance Association, Inc., 121 E. 18th St., New York, N. Y.

*Dance index;* a magazine devoted to dancing. 1942. m. $2 to educational institutions; others $2.50. Dance Index, 637 Madison Ave., New York, N. Y. Illus.

*Dance observer.* 1934. 10 times a year. $1.50. Dance Observer, 1 W. 67th St., New York, N. Y.

*Dancer's almanac and who's who.* 1940. a. Ruth E. Howard, Editor. New York, N. Y.

*Educational dance.* 1938. 10 times a year. $1.50. Educational Dance Co., 8184 Mannix Drive, Hollywood, Calif. Bk. Rev. Film Rev.

*Folk dancer.* 1941. m. $1. Box 201, Flushing Station, Long Island, N. Y. Illus.

## EUGENICS

*Eugenical news.* 1916. q. $3. American Eugenics Society, R. K. O. Building, New York, N. Y. Bibl. Bk. Rev. Index. Indexed: Bibl. Ind. Psycho. Abstr. Q. C. Ind. Med.

*International welfare journal.* 1887. q. $1. International Purity Association, Inc., 127 N. Wells St., Chicago, Ill.

*Journal of heredity.* 1910. m. $3.50. American Genetic Association, 308 Victor Bldg., Washington, D. C. Bibl. Illus. Index. Indexed: Agr. Ind. Bibl. Ind. Biol. Abstr. Chem. Abstr. Nutr. Abstr. Psycho. Abstr. Q. C. Ind. Med.

## FOODS

### Diet, Nutrition, Etc.

*American dietetic association.* Journal. 1925. m. $3. American Dietetic Association, 185 N. Wabash Ave., Chicago, Ill. Abstr. Bibl. Bk. Rev. Index. Indexed: Bibl. Ind. Biol. Abstr. Chem. Abstr. Nutr. Abstr. Q. C. Ind. Med.

*American journal of digestive diseases and nutrition.* 1934. m. $6. Gastro-Enterological Association, 435 Lincoln Tower, Fort Wayne, Ind. Abstr. Bk.Rev. Bibl. Illus. Index. Indexed: Biol. Abstr. Chem. Abstr. Nutr. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Diet Magazine.* 1933. m. $1.50. Diet Magazine, 161 W. Burton Place, Chicago, Ill.

*Food research.* 1936. bi-m. $4. Twin City Printing Co., Champaign, Ill. Bibl. Illus. Index. Indexed: Agr. Ind. Bibl. Ind. Biol. Abstr. Br. Chem. Abstr. Chem. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Food for health and enjoyment.* 1941. 10 times a year. $1. Sherman Foods Publishing Co., Inc., 373 Fourth Ave., New York, N. Y. Illus.

*Forecast for home economists.* 1910. m. (except July-Aug.) Controlled free distribution. Forecast Publishing Co., 6 E. 39th St., New York, N. Y. Bibl. Bk. Rev. Illus. Indexed: Bibl. Ind. P. A. I. S.

*Gastroenterology* (American gastroenterological association) 1943.

m. $6. Williams and Wilkins Co., Mt. Royal and Guilford Aves., Baltimore, Md., Abstr.

*Gourmet.* 1941. $3. Gourmet, Inc., 330 W. 42nd St., New York, N. Y. Illus.

*Journal of biological chemistry.* 1905. m. $4.50 per vol. Williams and Wilkins Co., Mount Royal and Guilford Aves., Baltimore, Md. Bibl. Illus. Index. Cum. Index: v. 1-125, 1905-1938. Indexed: Biol. Abstr. Chem.Abstr. Q.C.Ind.Med.

*Journal of home economics.* 1909. m.(Sept.-Je.) $2.50. American Home Economics Association, Mills Bldg., Washington, D. C. Abstr. Bibl. Bk.Rev. Index. Indexed: Agr. Ind. Bibl. Ind. Biol. Abstr. Bk.Rev.Dig. Chem. Abstr. Educ.Abstr. Educ.Ind. P. A. I. S. Psycho.Abstr. Q.C.Ind. Med. R. G.

*Journal of living.* 1935. m. $3. Journal of Living Publishing Corp., 1819 Broadway, New York 23, N. Y.

*Journal of nutrition.* 1928. m. $5 per vol. Wister Institute of Anatomy and Biology, 36th St. and Woodland Ave., Philadelphia, Pa. Bibl. Illus. Index. Cum.Index: v.1-15, 1928-Je. 1938. Indexed: Bibl.Ind. Biol.Abstr. Br.Chem.Abstr. Chem. Abstr. Nutr.Abstr. Q.C.Ind.Med.

*Nutrition reviews.* 1942 m. $2. Nutrition Foundation, Inc., Chrysler Bldg., New York, N. Y.

*Practical home economics.* 1923. m. $2. Lakeside Publishing Co., 468 Fourth Ave., New York, N. Y. Bk. Rev. Illus. Index. Indexed: Bibl.Ind. Educ. Ind. P.A.I.S.

*Review of gastroenterology.* 1934. Bim. $2.50. National Gastroenterological Association, Inc., 146 Central Park, W. New York, N. Y. Abstr. Bibl. Bk.Rev. Illus. Index. Indexed: Biol.Abstr. Chem.Abstr. Q.C.Ind.Med.

*Vegetarian, fruitarian, humanitarian,* 1896. m. $1. John Imthurn, Lewiston, Idaho.

*What's new in foods and nutrition.* 1942. m. $3. 919 North Michigan Ave., Chicago.

## HEALTH EDUCATION

### Safety, Training, Etc.

*American child.* 1919. m.(Oct.-May) $3. National Child Labor Committee, 419 Fourth Ave., New York, N. Y. Indexed: P. A. I. S.

*American journal of hygiene.* 1921. bi-m. $12. American Journal of Hygiene, 615 N. Wolfe St., Baltimore Md. Index. Cum. Index: v. 1-28, 1921-1938. Indexed: Biol. Abstr. Chem.Abstr. Psycho. Abstr. P. H. Eng. Abstr. Q. C. Ind. Med.

*American journal of public health. and the nation's health.* 1911. m. $5. American Public Health Association, 1790 Broadway, New York, N. Y. Abstr. Bibl. Bk. Rev. Index. Indexed: Bibl. Ind. Bk. Rev. Dig. Br.Chem.Abstr. Chem.Abstr. Eng. Ind. P. A. I. S. P. H. Eng. Abstr. Q.C. Ind. Med. R.G.

*Arizona. Board of health.* Arizona health news. m. Arizona State Board of Health, Phoenix, Ariz.

*Baltimore health news.* Maryland State Department of Health, Baltimore, Md. Indexed: P. H. Eng. Abstr.

*Better times.* 1921. w.(Oct.-May) $1. Welfare Council of New York City, 52 Wall St., New York, N. Y.

*Birmingham's health.* m. Jefferson County Board of Health, P. O. Box 2591, Birmingham, Ala. Indexed: P. A. I. S.

*Boston health bulletin.* m. Health Department, Boston, Mass.

*California. Department of public health.* Weekly bulletin. California State Department of Public Health, Sacremento, Calif. Indexed: P. H. Eng. Abstr.

*California physical education, health and recreation journal.* 1932. q. 75c to non-members. California Association for Health, Physical Education, and Recreation, 1100 South Fedora St., Los Angeles, Calif.

*Canadian journal of public health.*

1910. m. $2. Canadian Public Health Association, 111 Avenue Road, Toronto, Ontario. Bibl. Index. Indexed: Bibl. Ind. Biol. Abstr. Chem. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Chicago's health.* w. Chicago Board of Health. Chicago, Ill.

*Colorado Board of health.* Colorado state board of health bulletin. bi-m. Colorado State Board of Health, Denver, Colo.

*Colorado. Board of health.* Division of public health nursing. Bulletin. Colorado State Board of Health, Denver, Colo.

*Connecticut. Department of health.* Monthly health bulletin. Connecticut State Department of Health, Hartford, Conn. Indexed: P. H. Eng. Abstr.

*District of Columbia. Health department.* Capitol's health. 1941. m. District of Columbia Department of Health, Washington, D. C.

*Everybody's health.* 1916. m.(bi-m. Je.-Jl., Aug.-Sept.) 50c. Minnesota Public Health Association, 11 W. Summit Ave., St. Paul, Minn.

*Florida. Board of health.* Florida health notes. m. Florida State Board of Health, Jacksonville, Fla. Indexed: P. H. Eng. Abstr.

*Georgia. Department of health.* Georgia's health. m. Georgia State Department of Public Health, Atlanta, Ga. Indexed: P. H. Eng. Abstr.

*Good Health.* 1886. m. $1. Good Health Publishing Co., 271 W. Michigan Ave., Battle Creek, Mich.

*Health.* 1911. Michigan Anti-tuberculosis Association, Ann Arbor, Mich.

*Health.* 1934. m. $1.50. Pacific Press Publishing Association, Mountain View, Calif.

*Health;* a journal devoted to the promotion of personal and community health. 1933. Toronto, Ontario.

*Health and safety.* 1936. Boy Scouts of America, 2 Park Ave., New York, N. Y.

*Health bulletin for teachers.* 1929. Free. Metropolitan Life Insurance Co., School Health Bureau, Welfare Division, Newark, N. J.

*Health city sun.* 1929. w. $1. Health City Sun, Box 73, Albuquerque, New Mexico.

*Health culture.* 1894. m. $2. Harold W. Turner, 1133 Broadway, New York, N. Y.

*Health officer.* 1936. m. Price not given. United States Public Health Service, Office of Public Health Education, Washington. Bibl. Bk. Rev.

*Health rays.* 1919. m. $1. Kentville Publishing Co., Ltd., Kentville, Nova Scotia.

*Hygeia; the health magazine.* 1923. m. $2.50. American Medical Association, 535 N. Dearborn St., Chicago, Ill. Bk. Rev. Illus. Index. Indexed: P. A. I. S. P. H. Eng. Abstr. Psycho. Abstr. Q. C. Ind. Med. R. G.

*Illinois. Department of public health.* Educational health circular. State Department of Public Health, Springfield, Ill.

*Illinois. Department of public health.* Illinois health messenger. 1929. s-m. State Department of Public Health, Springfield, Ill.

*Indiana. Board of health.* Monthly bulletin. 1897. 25c. (Free to interested persons.) Indiana Division of Public Health, Indianapolis, Ind. Indexed: P. H. Eng. Abstr.

*Iowa. Department of health.* Iowa public health bulletin. q. Iowa State Department of Health, Des Moines, Ia.

*Iowa. Department of health.* Weekly health message. Iowa State Department of Health, Des Moines, Ia.

*Journal of health and physical education.* 1896. m.(Sept.-Je.) $2.50. American Association for Health, Physical Education, and Recreation, 1201 16th St., NW., Washington, D. C. Bibl. Bk.Rev. Illus. Index.

Indexed: Bibl. Ind. Educ. Abstr. Educ. Ind. Q. C. Ind. Med.

*Journal of living.* 1935. m. $3. Journal of Living Publishing Corp., 1819 Broadway, New York, N. Y.

*Journal of school health.* 1927. m. (Sept.-Je.) $2. American School Health Association, 3335 Main St., Buffalo, N. Y. Abstr. Bk. Rev. Index. Indexed: Educ. Abstr. Psycho. Abstr.

*Journal of social hygiene.* 1914. m. (Oct.-Je.) $3. American Social Hygiene Association, 1790 Broadway, New York, N. Y. Abstr. Bibl. Bk. Rev. Illus. Index. Cum. Index: v. 1-21, 1914-1936. Indexed: Bibl. Ind. Int. Ind. P. A. I. S. Psycho. Abstr. Q. C. Ind. Med.

*Kansas. Board of health.* Kansas state board of health news letter. m. Kansas State Board of Health, Topeka, Kan.

*Kentucky Board of health.* Bulletin. m. Kentucky State Board of Health, Louisville, Ky. Indexed: P. H. Eng. Abstr.

*Let's live.* 1933. s-m. $1. Clarke Irvine, 4657 Hollywood Blvd., Hollywood, Calif.

*Library index;* a weekly index to current periodical literature in the field of public health. 1921. w. $2.50. National Health Library, National Health Council, 1790 Broadway, New York, N. Y. Bibl.

*Life and health.* 1885. m. $1. Review and Herald Publishing Association, Takoma Park Station, Washington, D. C.

*Louisiana. Board of health.* Quarterly bulletin. Louisiana Board of Health, Baton Rouge, La. Indexed: P. H. Eng. Abstr.

*Maryland. Department of health.* Monthly bulletin. 1929. Maryland State Department of Health, Baltimore, Md. Indexed: P. H. Eng. Abstr.

*Massachusetts. Department of public health.* Commonwealth. Massachusetts Department of Public Health, Boston, Mass.

*Michigan. Department of health.* Michigan public health. 1906. m. Free. Michigan State Department of Health, Lansing, Mich. Indexed: P. H. Eng. Abstr.

*Monthly health letter.* 1910. m. $1. Dr. R. R. Daniels, 1550 Lincoln St., Denver, Colo.

*National health review.* 1933. q. Price not given. Department of Pensions and National Health, Ottawa, Ont. Abstr. Stat. Indexed: Psycho. Abstr. P. A. I. S.

*National institute of health.* Bulletin. National Institute of Health, Bethesda, Md. Indexed: P. H. Eng. Abstr.

*National negro health news.* 1933. q. Price not given. Federal Security Agency, U. S. Public Health Service, Washington, D. C. Bk. Rev. Illus.

*National safety education association.* Bulletin. q. $1. National Safety Education Association, 8 Fifth Ave., New York, N. Y.

*National safety news.* 1919. m. $4. National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Eng. Ind. Ind. Arts. P. A. I. S. P.H.Eng. Abstr. Q.C.Ind. Med.

*Nature's path.* 1896. m. $1. Benedict Lust Publications, 343 Lexington Ave., New York, N. Y.

*Nebraska. Department of health.* Bulletin. Nebraska State Department of Health, Lincoln, Nebr. Indexed: P. H. Eng. Abstr.

*New Hampshire. Board of health.* New Hampshire health news. m. New Hampshire State Board of Health, Concord, N. H. Indexed: P. H.Eng. Abstr.

*New Jersey. Department of health.* Public health news. 1917. bi-m. Price not given. New Jersey Department of Health, Trenton, N. J. Indexed: P. H. Eng. Abstr.

*New York. Department of health.*

Health news. w. New York Department of Health, Albany, New York.

*North Carolina. Board of health.* Health bulletin. m. North Carolina Board of Health, Raleigh, N. C. Indexed: P. H. Eng. Abstr.

*Ohio public health.* 1937. $1. Ohio Public Health Association, 1575 Neil Ave., Columbus, Ohio. Bk. Rev.

*Pennsylvania. Department of health.* Pennsylvania's health. m. Free. Pennsylvania State Department of Health, Harrisburg, Pa.

*Pests and their control.* 1933. m. $3. (Controlled free distribution.) The Extermination Log, 512 E. 14th St., Kansas City, Mo. Illus. Indexed: Bibl. Ind. Biol. Abstr.

*Philippine Islands. Bureau of health.* Monthly bulletin. 1921. Free. Bureau of Health, Government of the Philippine Islands, Department of Public Instruction, Manila, P. I.

*Public health nursing.* 1909. m. $3. National Organization of Public Health Nursing, Inc., 1790 Broadway, New York, N. Y. Bk. Rev. Illus. Index. Cum. Index: v. 1-6, 1909-1914. Indexed: Bibl. Ind. Int. Ind. P. A. I. S. Psycho. Abstr. Q. C. Ind. Med.

*Public health reports.* 1878. w. $2.50. U. S. Public Health Service, Federal Security Agency, Washington, D. C. Illus. Index. Stat. Indexed: Bibl. Ind. Eng. Ind. Ind. Arts. P. A. I. S. Q. C. Ind. Med.

*Public safety.* 1927. m. $3. National Safety Council, 20 N. Wacker Drive, Chicago, Ill. Illus. Stat. Indexed: P. A. I. S. Psycho Abstr.

*Puerto Rico. Department of health.* Puerto Rico health bulletin. 1937. m. Puerto Rico Department of Health, San Juan, Puerto Rico. Index. Indexed: P. H. Eng. Abstr.

*Puerto Rico journal of public health and tropical medicine.* 1926. q. Department of Public Health of Puerto Rico and the School of Tropical Medicine of the University of Puerto Rico, under the auspices of Columbia University, New York, N. Y. Indexed: Biol. Abstr. Chem. Abstr. P. H. Eng. Abstr. Q. C. Ind. Med.

*Safety education.* 1924. m. (Sept.-May.) National Safety Council, 20 N. Wacker Drive, Chicago, Ill. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Educ. Abstr. P. A. I. S.

*Safety engineering;* devoted to accident prevention, health conservation, and fire control. m. $3. Alfred M. Best Co., Inc., 75 Fulton St., New York, N. Y. Illus. Index. Indexed: Bibl. Ind. Chem. Abstr. Eng. Abstr. Ind. Arts. P. A. I. S.

*Sanitarian.* 1938. m. $2.50. National Association of Sanitarians, 206 W. 6th St., Los Angeles, Calif.

*School physicians' bulletin.* 1927. m. (Sept.-Je.) $1.50. American Association of School Physicians, 883 Broadway, Albany, N. Y.

*Successful living.* 1932. bi-m. $1 for 2 years. Successful Living, Inc., 683 Broadway, New York, N. Y.

*Veneral diseases information.* 1920. m. 50c. Controlled free distribution. U. S. Public Health Service, 19th St. and Constitution Ave., Washington, D. C. Abstr. Bibl. Indexed: Biol. Abstr. Chem. Abstr. P. A. I. S. Q. C. Ind. Med.

*Virginia. Department of health.* Health bulletin. m. Virginia Department of Health, Richmond, Va. Indexed: P. H. Eng. Abstr.

*Wisconsin. State board of health.* Quarterly bulletin. Wisconsin State Board of Health, Madison, Wis. Indexed: P. H. Eng. Abstr.

*Your health.* 1913. m. $2. British Columbia Tuberculosis Society, 555 Howe St., Vancouver, B. C. Bk. Rev. Illus.

*Your life.* 1937. m. $3. Kingsway Press., Inc., 354 Fourth Ave., New York, N. Y.

## HEATING, VENTILATING, LIGHTING

*Air conditioning and refrigeration news.* 1926. w. $4. Business News Publishing Co., 5229 Case Ave., Detroit, Mich. Illus. Indexed: Eng. Ind.

*American artisan.* 1880. m. $2. Keeney Publishing Co., 6 N. Michigan Ave., Chicago, Ill. Illus.

*Heating and ventilating.* 1904. m. $2. Industrial Press, 148 Lafayette St., New York, N. Y. Illus. Index. Indexed: Chem. Abstr. Eng. Ind. Ind. Arts. P. H. Eng. Abstr.

*Plumbing and heating journal.* 1881. m. $2. Angus Co., Inc., 515 Madison Ave., New York., N. Y. Illus. Pat. Indexed: Eng. Ind.

*Sanitary age.* 1923. m. $1. Age Publications, Ltd., 31 Willcocks St., Toronto, Ont. Illus.

## HYGIENE (Industrial)

*Industrial hygiene digest.* Industrial Hygiene Foundation of America, Pittsburgh, Pa. Indexed: P. H. Eng. Abstr.

*Industrial medicine;* the journal of occupational diseases and traumatic surgery. 1932. m. $5. Industrial Medicine Publishing Co., 540 N. Michigan Ave., Chicago, Ill. Bibl. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Biol. Abstr. Chem. Abstr. Ind. Arts. P. A. I. S. P. H. Eng. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Journal of industrial hygiene and toxicology;* with abstracts of the literature. 1919. m. (Sept.-Je.) $6. Williams and Wilkins Co., Mount Royal and Guilford Aves., Baltimore, Md. Abstr. Bibl. Bk. Rev. Illus. Index. Cum. Index: v. 1-17, 1919-1935. Indexed: Bibl. Ind. Br. Chem. Abstr. Chem. Abstr. Ind. Arts. P. A. I. S. Q. C. Ind. Med.

*Occupational hazards.* 1938. m. Free. Industrial Publishing Co., 812 Huron Road, Cleveland, Ohio.

## HYGIENE (Mental)

*American journal of psychiatry.* 1844. bi-m. $6.50. American Psychiatric Association, 9 Rockefeller Plaza, New York, N. Y. Bibl. Bk. Rev. Illus. Index. Indexed: Q. C. Ind. Med.

*Illinois psychiatric journal.* 1941. q. Price not given. Division of Mental Hospitals, Department of Public Welfare, Springfield, Ill. Bibl. Bk. Rev.

*Mental health bulletin.* 1921. Danville State Hospital, Department of Community Service, Danville, Pa.

*Mental health sentinel.* q. Massachusetts Society for Mental Hygiene, Boston, Mass.

*Mental hygiene.* 1917. q. $3. National Committee for Mental Hygiene, Inc., 1790 Broadway, New York, N. Y. Bibl. Bk. Rev. Index. Indexed: Br. Subj. Ind. Int. Ind. P. A. I. S. Psycho. Abstr. Q. C. Ind. Med.

*Mental hygiene news.* 1930. m. (Sept.-Je.) Price not given. New York State Department of Mental Hygiene, State Office Bldg., Albany, N. Y.

*Mental hygiene review.* 1940. bi-m. $2. Indiana Society for mental Hygiene, 141 S. Meridian St., Indianapolis, Ind.

*Psychiatric quarterly.* (New York state department of mental hygiene.) 1927. q. $2. State Hospital Press, Utica, N. Y. Bibl. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Q. C. Ind. Med.

*Psychiatric quarterly supplement.* (New York state department of mental hygiene.) 1927. s-a. $1. State Hospitals Press, Utica, N. Y. Bibl. Bk. Rev. Stat. Index. Indexed: Bibl. Ind.

*Psychiatry;* journal of the biology and the pathology of inter-personal relations. 1938. q. $6. William Alanson White Psychiatric Foundation, Inc., 1500 Greenwood Ave., Baltimore, Md. Bibl. Bk. Rev. Index. Indexed: Bibl. Ind. Psycho. Abstr. Q. C. Ind. Med.

*Psychosomatic medicine;* experimental and clinical studies. (Supplements.) 1939. q. $5. Division of Anthropology and Psychology, National Research Council, 2101 Constitution Ave., Washington, D. C. Abstr. Bibl. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Biol. Abstr. Psycho. Abstr. Q. C. Ind. Med.

HYGIENE (Mother and Child)

*Child development.* 1930. q. $4. Society for Research in Child Development, National Research Council, 2101 Constitution Ave., Washington, D. C. Bibl. Illus. Index. Indexed: Educ.Abstr. Nutr. Abstr. Psycho. Abstr.

*Child development abstracts and bibliography.* 1927. bi-m. $5. Society for Research in Child Development, National Research Council, 2101 Constitution Ave., Washington, D. C.

*Children's association news.* 1924. 6 times a year. 20c. Westchester County Children's Association, Inc., 8 Church St., White Plains, N. Y.

*Everybody's health.* 1916. m.(bi-m. Je.-Jl., Aug.-Sept.) 50c. Minnesota Public Health Association, 11 W. Summit Ave., St. Paul, Minn.

*Frontier nursing service.* Quarterly bulletin. 1925. q. $1. Frontier Nursing Service, Lexington, Ky.

HYGIENE (Public)

*American journal of hygiene.* 1921. bi-m. $12. School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Md. Index. Cum. Index: v. 1-28, 1921-1938. Indexed: Biol. Abstr. Chem. Abstr. P. H. Eng. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*American journal of public health and the nation's health.* 1911. m. $5. American Public Health Association, 1790 Broadway, New York, N. Y. Abstr. Bibl. Bk. Rev. Index. Indexed: Bibl. Ind. Bk. Rev. Dig. Chem. Abstr. Eng. Ind. P. A. I. S. P. H. Eng. Abstr. Q. C. Ind. Med. R. G.

*Canadian journal of public health.* 1910. m. $2. Canadian Public Health Association, 111 Avenue Road, Toronto, Ont. Bibl. Index. Indexed: Bibl. Ind. Biol. Abstr. Chem. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Good health.* (Race betterment foundation.) 1866. $1. Good Health Publishing Co., 271 W. Michigan Ave., Battle Creek, Mich.

*Health;* a doctor's magazine for everybody. 1934. m. $1.50. Pacific Press Publishing Association, Mountain View, Calif.

*Hygeia; the health magazine.* 1923. m. $2.50. American Medical Association, 535 N. Dearborn St., Chicago, Ill. Bk. Rev. Illus. Index. Indexed: P. A. I. S. P. H. Eng. Abstr. Q. C. Ind. Med. R. G.

*Journal of social hygiene.* 1914. m. (Oct.-Je.) $3. American Social Hygiene Association, 1790 Broadway, New York, N. Y. Bibl. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Int. Ind. P. A. I. S. Psycho. Abstr. Q. C. Ind. Med.

*Library index;* a weekly index to current periodical literature in the field of public health. 1921. w. $2.50. National Health Library, National Health Council, 1790 Broadway, New York, N. Y. Bibl.

*Milbank memorial fund quarterly.* 1923. q. $1. Milbank Memorial Fund, 40 Wall St., New York, N. Y. Bibl. Bk. Rev. Index. Indexed: Biol. Abstr. P. A. I. S. Psycho. Abstr.

*National health review.* (Text and title in English and French.) 1933. q. Price not given. Department of Pensions and National Health, Ottawa, Ont. Abstr. Stat. Indexed: P. A. I. S. Pyscho. Abstr.

*National negro health news.* 1933. q. Price not given. Federal Security Agency, United States Public Health Service, Washington, D. C. Bk. Rev. Illus.

*Oficina sanitaria panamericana.* Boletin. (Text in several languages.)

1922. m. Price not given. Oficina Sanitaria Panamericana, Washington, D. C. Abstr. Bibl. Illus. Indexed: Q. C. Ind. Med.

*Practical home economics;* for teaching nutrition, food, hygiene, clothing, homemaking, and health. 1927. m. $2. Lakeside Publishing Co., 468 Fourth Ave., New York, N. Y. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Educ. Ind. P. A. I. S.

*Public health bulletin.* (United States public health service.) 1881. irreg. 20c per no. Superintendent of Documents, Washington, D. C. Bibl. Illus. Indexed: P. H. Eng. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Public health reports.* (United States public health service. (Supplements.) 1878. w. $2.50. Superintendent of Documents, Washington, D. C. Stat. Index. Indexed: Bibl. Ind. Eng. Ind. Ind. Arts. P. A. I. S. P. H. Eng. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Public health reviews;* including summaries of current books, selected articles and pamphlet material. University of Michigan, Division of Hygiene and Public Health, Ann Arbor, Mich. Indexed: P. A. I. S.

*Puerto Rico journal of health and tropical medicine.* (School of tropical medicine, University of Puerto Rico.) (Text in English and Spanish.) 1925. q. $4. Columbia University Press. 2960 Broadway, New York, N. Y. Illus. Indexed: Biol. Abstr. Chem. Abstr. Q. C. Ind. Med.

*Revista medico, social de la sanidad y beneficencia municipal.* 1941. q. Price not given. Jefatura da Sanidad Municipal Habana, Cuba. Bibl. Illus. Indexed: Q. C. Ind. Med.

*Salubridad y asistencia social* (Ministerio de salubridad y asistencia social.) (Supplement.) 1909. m. Free. Instituto Finlay, Biblioteca, Habana, Cuba. Abstr. Stat. Index.

*Sewage works engineering and municipal sanitation.* 1930. m. $2. Case-Shepperd-Mann Publishing Corp., 24 W. 40th St., New York, N. Y. Bk. Rev. Illus. Index. Indexed: Chem. Abstr. Eng. Ind. P. A. I. S. P. H. Eng. Abstr.

*Sewage works journal.* 1929. bi-m. $3. W. H. Wisely, Box 18, Urbana, Ill. Abstr. Bibl. Bk. Rev. Illus. Index. Indexed: Biol. Abstr. Br. Chem. Abstr. Chem. Abstr. Eng. Ind. P. H. Eng. Abstr. Q. C. Ind. Med.

*Vida nuevo; revista mensual de medicina y cirugia.* 1909. m. $3. Manzana de Gomez, 222 Habana, Cuba. Abstr. Bibl. Bk. Rev. Illus. Index. Cum. Index: v. 1-11. Indexed: Q. C. Ind. Med.

*Water works and sewerage.* 1890. m. $2. Gillete Publishing Co., 330 Wells, Chicago, Ill. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Biol. Abstr. Chem. Abstr. Eng. Ind. Ind. Arts.

## MOUNTAINEERING

*Adirondack mountain club.* Bulletin. 1937. bi-m. Price not given. Adirondack Mountain Club. 55 Liberty St., New York, N. Y.

*American alpine journal.* 1929. American Alpine Club, 140 E. 46th St., New York, N. Y. Indexed: Mag. Subj. Ind.

*Appalachia.* 1876. s-a. $2. Appalachian Mountain Club, 5 Joy St., Boston, Mass. Cum. Index: v. 1-10, 1876-1904. Indexed: Mag. Subj. Ind.

*Appalachian trailway news.* 1940. q. $1 Appalachian Trail Conference, 808 Seventeenth St., N. W., Washington, D. C.

*California out-of-doors.* 1914. Frequency not given. Membership. Tamaloais Conservation Club, Pacific Bldg., San Francisco, Calif. Illus.

*Canadian alpine journal.* 1907. Annual. Alpine Club of Canada, Banff, British Columbia. Index. Indexed: Mag. Subj. Ind.

*Mazama.* 1896. m. $2. Mazama, 520 S. W. Yamhill St., Portland, Ore.

Index. Indexed: Mag. Subj. Ind.

*Mountaineer.* 1907. m. (Jan.-Nov.) s-m. (Dec.) Mountaineer, Inc., Box 122, Seattle, Wash. Index. Indexed: Mag. Subj. Ind.

*Potomac Appalachian trail club.* Bulletin. 1923. q. 15c per no. 808 Seventeenth St., N. W., Washington, D. C. Bk. Rev.

*Prairie club* [Bulletin]; organized for the promotion of outdoor recreation in the form of walks, outings, camping and canoeing. No. 45., 1917. m. (Sept.-Je.) $1.25. 31 S. Clark St., Chicago, Ill.

*Sierra club bulletin.* 1893. bi-m. $1. Sierra Mountain Club, 220 Bush St., San Francisco, Calif. Bk. Rev. Illus. Index. Cum. Index: v. 13-16, 1928-1931. Indexed: Mag. Subj. Ind.

*Trail and timberline.* 1918. m. $1.50. Colorado Mountain Club, Mining Exchange Bldg., Denver, Colo. Illus.

*Trails.* 1920. m. Price not given. California Alpine Club, Pacific Bldg., San Francisco, Calif.

## PHYSICAL CULTURE

*Beauty and strength.* 1897. m. $2.50. Macfadden Publications, Inc., 122 E. 42nd St., New York, N. Y.

*Strength and health.* 1932. m. $1.50. Strength and Health Publishing Co., 51 N. Broad St., York, Pa.

## PHYSICAL EDUCATION

*American turner.* (German and English.) 1885. s-m. $2. Turner Publishing Co., New Ulm, Minn.

*California physical education, health and recreation journal.* 1932. q. 75c for non-members. California Association of Health, Physical Education, and Recreation, 1110 South Fedora St., Los Angeles, Calif.

*Iowa. University. Division of physical education.* Physical education bulletin (Palaestra patter.) 1940. 2 or 3 times a year. Price not given. Division of Physical Education, State University of Iowa, Iowa City, Ia.

*Journal of health and physical education.* 1896. m. (Sept.-Je.) $2.50. American Association for Health, Physical Education, and Recreation, 1201 16th St., N. W., Washington, D. C. Bibl. Bk. Rev. Illus. Index. Indexed: Bibl. Ind. Educ. Abstr. Educ. Ind. Q. C. Ind. Med.

*Journal of physical education.* 1901. bi-m. $1.50. National Y. M. C. A. Physical Education Society, Dayton, Ohio.

*N. C. A. A. news bulletin.* 1933. irreg. Price not given. National Collegiate Athletic Association, Chicago, Ill.

*Physical educator.* 1940. 5 times a year. Membership; others $1.50. Phi Epsilon Kappa Fraternity, 1537 W. 29th St., Indianapolis, Ind.

*Progressive physical educator.* v. 19, 1937, s-a 50c per no. Phi Delta Pi, 425 E. 4th St., Cincinnati, Ohio.

*Research quarterly.* 1930. q. $3. American Association for Health, Physical Education, and Recreation, 1201 16th St., N. W., Washington, D. C. Bibl. Bk. Rev. Index. Indexed: Bibl. Ind. Educ. Ind.

*Scholastic coach.* 1931. m. (Sept.-May.) $1.50. G. H. McCracken, 220 E. 42nd St., New York, N. Y. Bk. Rev. Index.

*Winged foot.* 1892. m. $2. New York Athletic Club, 290 Alta Vista Drive, Yonkers, N. Y. Bk. Rev. Illus.

## PHYSICAL THERAPY

*Archives of physical therapy.* 1920. m. $5. American Congress of Physical Therapy, 30 N. Michigan Ave., Chicago, Ill. Abstr. Bk. Rev. Illus. Index. Indexed: Biol. Abstr. Chem. Abstr. Nutr. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Physiotherapy review.* 1921. bi-m. $2.50. American Physiotherapy Association, 737 N. Michigan Ave., Chicago, Ill. Abstr. Bibl. Bk. Rev. Illus. Index. Indexed. Q. C. Ind. Med.

## PHYSIOLOGY

*American journal of physiology.* 1898. m. $7.50 per volume. American Physiological Society, 19 W. Chase St., Baltimore, Md. Bibl. Index. Cum. Index. v. 1-120. 1898-1937. Indexed: Biol. Abstr. Chem. Abstr. Psycho. Abstr. Q. C. Ind. Med.

*Journal of general physiology.* 1918. bi-m. $5. Rockefeller Institute for Medical Research, 66th St. and York Ave., New York, N. Y. Bibl. Illus. Index. Indexed: Biol. Abstr. Br. Chem. Abstr. Chem. Abstr. Pyscho. Abstr. Q. C. Ind. Med.

*Physiological reviews.* 1921. q. $6. American Physiological Society, 19 W. Chase St., Baltimore, Md. Indexed: Chem. Abstr. Educ. Absti Psycho. Abstr. Q. C. Ind.Med.

## PLAYS AND PAGEANTS

*Playgrounds, Recreation, Leisure. California physical education, health, and recreation journal.* 1932. q. 75c for non-members. California Association for Health, Physical Education, and Recreation, 1110 S. Fedora St., Los Angeles, Calif.

*Empressario internacional*-cine, radio, sports, foto. (Spanish.) 1940. bi-m. $1. Specialized Export Publications, Inc., 220 W. 42nd St., New York, N. Y. Illus.

*Parks and recreation.* 1917. m. $3. American Institute of Park Executives, 4941 Elliot Ave., Minneapolis, Minn. Illus. Index. Indexed: P. A. I. S.

*Recreation.* 1907. m. $2. National Recreation Association, 315 Fourth Ave., New York, N. Y. Bibl. Bk. Rev. Illus. Index. Indexed: P. A. I. S. R. G.

## SCOUTING

*American girl.* 1917. m. $1.50. Girl Scouts, Inc., 155 E. 44th St., New York, N. Y. Bk. Rev. Illus. Index.

*Boy scout handbook.* 1910. 2 to 4 times a year. 50c per mo. Boy Scouts of America, 2 Park Ave., New York, N. Y.

*Boy's life;* the boy scouts' magazine. 1911. m. $1.50. Boy Scouts of America, 2 Park Ave., New York, N. Y.

*Guardian;* a bulletin of news and suggestions for leaders of camp fire girls. m. (Sept.-Je.) 75c. Camp Fire Club, Inc., 88 Lexington Ave., New York, N. Y. Illus. Index.

*Local council exchange;* a leader's digest. 1938. q. $1. Boy Scouts of America, 2 Park Ave., New York, N. Y.

*Scouting;* a magazine of information and ideas for all Scouters. 1913. m. (Sept.-Je.) $1. Boy Scouts of America, 2 Park Ave., New York, N. Y. Bk. Rev. Illus. Index.

*Scouting in central Ohio.* 1937. m. 10c. Central Ohio Area Council, Boy Scouts of America, London, Ohio.

## TRAP SHOOTING

*American riflemen.* 1885. m. $3. National Rifle Association of America, Inc., 1600 Rhode Island Ave., Washington, D. C. Illus.

*Sportsmen's review;* digest of trap-shooting. (American trap shooting association.) 1890. w. $4. Sportsmen's Reviews Publishing Co., Inc., 22 E. 12th St., Cincinnati, Ohio. Illus.

*U. S. R. A. bulletin.* 1904. bi-m. 50c. United States Revolver Association, 5 Oak St., Springfield, Mass.

## WOMEN'S SPORTS AND ATHLETICS

*Sportswoman;* devoted to the interests of women's club, college and school sports. 1924. m. (Sept.-Je.) $3. Sportswoman's Guild, Inc., 5800 Mervine St., Philadelphia, Pa.

*Woman bowler.* 1936. m. (Sept.-Apr.) bi-m. (May-Je.) $1. Women's International Bowling Congress, Inc., 608 S. Dearborn St., Chicago, Ill.

## MISCELLANEOUS

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## ABBREVIATIONS

| | |
|---|---|
| Abstr. | abstracts |
| Bibl. | bibliographies |
| Bk. Rev. | book reviews |
| Illus. | illustrations |
| Index | index (annual or volume) |
| Cum. Index | cumulative index |
| Pat. | patents |
| Stat. | statistics |
| Tr. Lit. | trade literature |
| Tr. M. | trade marks |
| a. | annually |
| bi-m. | bi-monthly |
| irreg. | irregular |
| m. | monthly |
| q. | quarterly |
| s-a. | semi-annually |
| s-m. | semi-monthly |
| s-w. | semi-weekly |
| w. | weekly |

## ABBREVIATIONS OF INDEXING AND ABSTRACTING SERVICES

| | |
|---|---|
| Agr. Ind. | Agricultural index |
| Bibl. Ind. | Bibliographic index |
| Biol. Abstr. | Biological abstracts |
| Bk. Rev. Dig. | Book review digest |
| Br. Chem. Abstr. | British chemical abstracts |
| Br. Subj. Ind. | British subject index |
| Chem. Abstr. | Chemical abstracts |
| Educ. Abstr. | Education abstracts |
| Educ. Ind. | Education index |
| Eng. Ind. | Engineering index |
| Ind. Arts | Industrial arts index |
| Int. Ind. | International index |
| Mag. Subj. Ind. | Annual magazine subject index |
| Nutr. Abstr. | Nutrition abstracts |
| P. A. I. S. | Public affairs information service bulletin |
| P. H. Eng. Abstr. | Public health engineering abstracts |
| Psycho. Abstr. | Psychological abstracts |
| Q. C. Ind. Med. | Quarterly cumulative index medicus |
| R. G. | Readers' guide to periodical literature |

# An Analysis of Certain Factors in the Gait of College Women

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## INTRODUCTION

THE most successful and efficient methods of performing many sport skills have been discovered and analysed for the purpose of teaching them to others. Many authorities have devised means, both subjective and objective, of analysing standing posture and have thus greatly facilitated the teaching of correct body mechanics in the standing position. These analyses have in some measure pointed out the factors which contribute to good and poor posture. Thus far, the kinesiological analyses of normal human locomotion have failed to reveal consistently contributory factors to good or poor gait.

This study was undertaken in an effort to determine whether the gait of an individual was related in any way to certain easily measurable factors, and secondly, whether a "good" gait could be differentiated from a "poor" gait in terms of the movements and relationships of specific body segments.

## REVIEW OF LITERATURE

In 1932 Kelly [13] * made a study of the relationship of standing posture to habitual carriage on forty-nine freshmen at Wellesley College. Several posture pictures were taken of each subject, one of each being taken without the subject's knowledge. All the pictures were graded by the Wellesley Objective Method.[19] Judges also graded the subjects as they walked around the gymnasium, unaware that they were being observed. Moving pictures were taken of the same subjects while they walked on a treadmill. The films were graded by judges. The findings of this study indicate that:

"1. There is a carry-over from still posture to walking posture.

"2. Habitual standing posture is an important factor in carriage."[13]

Thompson continued that study the following year by attempting to "evaluate walking from the postural standpoint on the basis of an objective grading system and to determine the relationship of posture in walking to other postural criteria."[33] The subjects were

* Superior figures refer to numbered bibliography at end of article.

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photographed while walking on a treadmill at slow, medium, and fast speeds. These films were graded subjectively by judges, and objectively by an adaptation of the Wellesley Objective Method of grading standing posture. Thompson found that the objective walking grades correlated more highly with the natural standing posture grades than with the best standing posture grades, and that there was no relationship between motor ability and walking posture.[33] Concerning this objective method of grading walking posture Thompson commented:

> The objective ratings given in the present study have a questionable reliability. It has not been determined how far one can go in applying static criteria, such as was done in the use of MacEwan's scale, to the dynamic situation.[33]

A study of the mechanics of graceful and ungraceful walking was made by Bass, in which she tried to determine the components of a graceful and an ungraceful walk. By popular vote of student judging committees a group of good walkers and a group of poor walkers were picked from approximately nine hundred university women. A student-faculty committee of judges observed and graded these subjects as they walked across a stage. From this relatively popular point of view it was found that the ungraceful girl tends:

"1. To carry her arms back of her body.

"2. To carry her arms in a jerky fashion and in an angular relationship to the body.

"3. To have a peculiar lower arm carriage.

"4. To have an exaggerated position of the head, usually carried forward at a marked angle and to have an emphasized movement or jerk of the head.

"5. To zig-zag various members of her body, rather than to move them in harmony with the whole.

"6. To exaggerate movements sideward, up and down, and combine these unharmoniously with those forward.

"7. To have stiff feet that act as units lacking in flexibility and forceful push.

"8. To either hold the trunk rigid, thus inhibiting possible drive for arms and legs or to push the hips forward, and the shoulders back, lower the chest and hold the head forward."[2]

It was found that the graceful girl tends:

"1. To move her various members in harmony with each other.

"2. To move so that a particular point, as the tip of the shoulders, moves across the screen in a wave, rather than in a zig-zag manner.

"3. To carry her arms more nearly in general line with her body, swinging them as much in front as in back and moving fairly in line with the body when the feet pass each other.

"4. To have a vigor of arm swing and a vigor of leg swing.

"5. To swing her legs from the hips with a sustained pushing of the body forward.

"6. To lift the head and chest easily and strongly, giving an impression of upness.

"7. To place the heels definitely but easily and smoothly in a direct line, one with the other, and to transfer to toe and on into the next phase of the stride—the great toe giving a definite push-off.

"8. To carry the head, shoulders, hips, knees, and ankles generally in good alignment as they swing through the mid-position of the stride; and to deviate very slightly from the alignment in changing from one phase of a stride to the next. The trunk is straight in the mid-stride position, and is inclined slightly forward or backward with the stride drive."[2]

These judgments were also made from moving pictures taken of the ten most graceful walkers and the fifteen most ungraceful walkers. Stick figures were made from these films and the typical differences between the two groups were shown in angular measurements. The angles were found to be very small in the graceful walkers and large in the ungraceful walkers. It is interesting to note the importance which Bass attaches to the psychological factors involved in the teaching of graceful walking to university women.

## STATEMENT OF THE PROBLEM

The purpose of this problem is threefold: (1) to determine whether the gait of an individual as rated by competent judges is related in any way to certain easily measurable factors such as motor ability, standing posture, and the location of the center of gravity; (2) to determine whether a good gait can be differentiated from a poor gait in terms of the movements and relationships of specific body segments; and (3), if possible to make certain suggestions as to how the findings of this study might be used in teaching girls to walk more gracefully.

The basic data for the analysis of gait is to be obtained from motion pictures of the subjects, showing front, back, and side views of their customary manner of walking.

## SELECTION OF SUBJECTS

The subjects were selected from approximately four hundred members of the freshmen class at Wellesley College in the fall of 1940. From these four hundred cases those whose medical records indicated the presence of some structural defect or who were restricted as to activity by the examining physicians were eliminated. From the remaining group one hundred and one subjects were selected in such a way that the distribution of the posture grades (obtained by the Wellesley Objective Method) followed the normal probability curve.

## PROCEDURE

Each subject came to be measured and photographed clad in the light blue briefs of the regulation gymnasium suit, a brassiere, and white sneakers. The subjects were informed of the purpose of the study and told that the results of the study would be confidential and would in no way affect their grades on previous posture pictures or have any bearing on their work in physical education classes in the future. It was also stressed that the purpose of taking the pictures was to record the student's habitual gait rather than her "best" gait.

### Determining the Center of Gravity

The total weight of each subject was taken and recorded. The center of gravity of each individual in the erect position was determined according to the method described by Lovett.[15] The apparatus for taking the center of gravity measurements in the erect position consisted of a board one meter in length and twelve inches in width, equipped with knife edges set flush with and across each end. The length of one edge of the board was calibrated in centimeters. In the center of this board at the fifty centimeter mark a small post six inches high was erected. One end of the board was supported on a block on the center of the scale platform. The other end was supported by a similar block in such a manner that the board when in place was horizontal and parallel to the floor. In this position the board registered five pounds on the scale. The location of the antero-posterior center of gravity relative to the internal malleolus of each subject was computed by the formula:

$$\frac{\text{Body Weight}}{\text{Weight Registered on Scale}} = \frac{\text{Length of Board}}{X}$$

Three readings were taken.

The apparatus for taking the center of gravity measurement in the supine position consisted of a board similar to the one described above but seventy-two inches in length and registering seven pounds on the scale when in place. The length of one edge of this board was calibrated in inches. A small foot board of pressed wood was attached at right angles to the scale end of the board. The long board was adjusted on the scale and the subject asked to lie down on it on her back with her feet toward the scale so that the soles of her sneakers touched the foot board. The hands of the subject were placed palms down on the tops of the thighs. The reading was taken on the scale and recorded as before. The distance from the subject's feet to the top of her head was measured by means of the calibrations along the side of the board, a small carpenter's square being used to determine the level of the head in relation to the edge of the board. The distance from the subject's feet to the crest of the ilium on the left side was measured in the same manner. The readings were taken to the nearest quarter of an inch. The position of the center of

gravity in relation to the total length of each individual was computed from the formula:

$$\frac{\text{Body Weight}}{\text{Balanced Weight}} = \frac{\text{Length of Subject}}{X}$$

This is an adaptation of Lovett's formula referred to above.

### Photographing the Subjects

The camera used in photographing the one hundred and one subjects was a Cine Ansco Model B equipped with a Wollensak f. 1. 5. cine Velostigmat one-inch lens. The speed of the camera was set at one, the shutter opening used was four and the distance setting on the lens was twenty-five feet. The camera was held stable during the filming three feet and one half inches from the floor. The film used was Agfa sixteen millimeter Super Panchromatic SSS Reversible.

The background was black, of dull cotton material hung on a wire across and at each end of the space where the pictures were to be taken. Four one-inch squares of white tape were placed on the back curtain in such a manner that the two top squares were six feet apart and six feet from the floor; the two lower squares were six inches from the floor and six feet apart. The area thus enclosed formed the background for photographing the subjects. Just to the right of the center of the backdrop a plumb line was hung on a white tape one half inch in width. Six feet in front of the center of the back curtain an "X" was marked on the floor and six feet in front of this a short line was drawn on the floor from right to left.

Before the photographs were taken, certain anatomical landmarks were made distinguishable by means of black Decco tape one inch wide. One strip four inches long was placed across the acromion process. One strip eight inches long was placed over each iliac crest beginning at the anterior superior iliac spine and continuing posteriorly. A one-inch square of tape was placed over the head of the radius, the styloid process of the ulna, the greater trochanter of the femur, the styloid process of the fibula and the lateral malleolus, on both sides of the subject. White bathing caps were worn to keep the hair from hiding the front and back lines of the neck and to make the position of the head more easily distinguishable.

After the guiding marks on the floor and the curtains were pointed out to the subject, she was instructed to walk across the floor from left to right in front of the camera on signal from the photographer, then turn, and at a second signal walk back to the starting point. The subject took a position just to the left of the plumb line against the back curtain facing the camera. From this point she walked toward the camera, at the photographer's signal, past the white cross line twelve feet from the back curtain, indicating to the photographer when she crossed this line. The subject now turned

around so that she was facing the back curtain and toeing the aforementioned cross line. At a signal from the photographer the subject walked away from the camera to the back curtain just to the left of the plumb line.

### Construction of the Rating Sheet

A mimeographed form which had been used in analysing gait in an experimental project at Wellesley College was used as a basis for a rating sheet.* Conferences with three members of the Department of Hygiene and Physical Education were held for the purpose of revising this gait analysis sheet so that it might be used by the judges in analyzing and grading the gait of the one hundred and one subjects as shown in the moving pictures. The form used is shown in Figure 1.

For the purpose of classifying the total gait of each individual a rating scale was devised as follows:

7—Excellent
6—Superior
5—Above Average
4—Average or medium
3—Below average
2—Inferior
1—Very poor

No attempt was made to define a "good" or a "poor" gait. What constituted a "good" or a "poor" gait was left to the opinion of the judges.

### Selection of the Judges

Three judges were selected from the faculty of the Department of Hygiene and Physical Education at Wellesley College and three were selected from the Department of Physical Education for Women at Syracuse University. Three of the judges are professionally interested in the teaching of body mechanics, one is an instructor in the dance and two are instructors in physical education activities.

### Analysis of Gait

Before showing the films the investigator attempted to clarify and define for the judges the terms used on the analysis sheets in order that the judgments could be made from a common basis.

The films were shown at the rate of sixteen frames per second. The complete view of each subject was shown repeatedly until the judges had checked the column headed "General" on the analysis sheet and given a total grade to the gait. The side views of the subject were then shown until the judges had completed that analysis. The front and back views were shown until the judges' analyses were complete. In some cases after the total grade had been marked the

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FIGURE I
ANALYSIS OF GAIT

Subject No..... Judged by..... Date.....

SIDE VIEW

*General*
- ☐ Relaxed
- ☐ Tensed
- ☐ Over relaxed
- ☐ Smooth
- ☐ Jerky
- ☐ Exag. spring

Alignment:
- ☐ Good
- ☐ Fair
- ☐ Poor

Poise:
- ☐ Normal
- ☐ Forward
- ☐ Backward

Speed:
- ☐ Moderate
- ☐ Rapid
- ☐ Slow

*Head*
- ☐ Erect
- ☐ Forward
- ☐ Tipped down
- ☐ Tilted up

*Shoulders*
- ☐ Well balanced
- ☐ Forward
- ☐ Retracted
- ☐ Over relaxed
- ☐ Tensed
- ☐ High (elevated)

*Arms*

Swing:
- ☐ Medium
- ☐ Long
- ☐ Short
- ☐ Exag. forward
- ☐ Exag. backward
- ☐ Restr. forward
- ☐ Restr. backward

Elbows:
- ☐ Normal
- ☐ Tense
- ☐ Over relaxed
- ☐ Flexed
- ☐ Straight

*Pelvis*

Pelvic inclination:
- ☐ Normal
- ☐ Increased
- ☐ Decreased

*Legs*

Stride:
- ☐ Medium
- ☐ Long
- ☐ Short

Hip Swing:
- ☐ Free
- ☐ Restricted

Knee Swing:
- ☐ Medium
- ☐ Exaggerated
- ☐ Restrained

Supporting Knee:
- ☐ Straight
- ☐ Hyperextended

*Feet*

Step:
- ☐ Medium
- ☐ Light
- ☐ Heavy

Push Off:
- ☐ Strong
- ☐ Weak
- ☐ Exaggerated

Dorsi-flexion:
- ☐ Normal
- ☐ Increased
- ☐ Decreased

FIGURE I (Cont.)

FIGURE I (Cont.)
ANALYSIS OF GAIT
FRONT AND BACK VIEWS

| *General* | *Head* | *Shoulders* | *Arms* | *Pelvis* | *Legs* | *Feet* |
|---|---|---|---|---|---|---|
| ☐ Relaxed | Tilt: | ☐ Even | Swing: | Lateral Tilt: | Stride: | Ankles: |
| ☐ Tensed | ☐ Left | ☐ High | ☐ Straight | ☐ Normal | ☐ Steady | ☐ Straight |
| ☐ Over relaxed | ☐ Right | ☐ Low | ☐ Across forward | ☐ Exaggerated | ☐ Weaving | ☐ Pronated |
| | Rotation: | ☐ Relaxed | ☐ Across backward | ☐ Restricted | ☐ Straight | ☐ Supinated |
| | ☐ Left | ☐ Tensed | Elbow: | Twist: | ☐ Oblique | Toes point: |
| | ☐ Right | ☐ Over relaxed | ☐ In | ☐ Normal | Space between knees: | ☐ Straight |
| | ☐ Erect | ☐ Exaggerated lift | ☐ Out | ☐ Exaggerated | ☐ Normal | ☐ In |
| | | Twist: | Hands: | ☐ Restricted | ☐ Close | ☐ Out |
| | | ☐ Normal | ☐ Palms in | | ☐ Wide | Foot swing: |
| | | ☐ Exaggerated | ☐ Palms forward | | | ☐ Straight |
| | | ☐ Restricted | ☐ Palms backward | | | ☐ Circle out |
| | | | | | | Space between feet: |
| | | | | | | ☐ Normal |
| | | | | | | ☐ Close |
| | | | | | | ☐ Wide |

Total Grade.....

film was stopped momentarily to allow the judges to ascertain more accurately the positions of the segments of the body during certain phases of the gait.

Two of the judges analyzed the gait of all one hundred and one subjects, two of the judges analyzed the gait of the first forty-nine subjects, and two of the judges analyzed the gait of the last fifty-two subjects—thus making a total of four judgments on each subject.

## ANALYSIS OF THE DATA

### The Gait Grade

An average of the four gait grades for each subject was computed and was designated as "the gait grade" for the individual.

The reliability of each of the six judges was determined by correlating the grades given by an individual judge with the average grades. The results of these correlations are shown in Table I.

TABLE I

Correlation of Ratings Made by Each Judge With the Combined Rating of Four Judges

| | |
|---|---|
| Judge A | .88 |
| Judge B | .85 |
| Judge C | .80 |
| Judge D | .70 |
| Judge E | .66 |
| Judge F | .46 |
| Average | .73 |

### Correlational Analysis

Correlations were computed between average gait grades and the antero-posterior posture grades (as determined by the Wellesley Objective Method), the score on the Wellesley Motor Ability Test (given in the fall of 1940), the Motor Quotient (derived from the Iowa General Motor Capacity Test), the height of the center of gravity (as determined in the supine position), the horizontal distance of the center of gravity in the antero-posterior plane from the internal malleolus. In no case did the correlations prove significant. The multiple correlation of the Gait Grade with the Posture Score and the Motor Quotient was found to be .34, indicating that the Gait Grade is related to posture and motor capacity but that this relationship is too slight to be of practical significance (see Table II). Considering the size of the zero order correlations it seemed unwise to attempt to analyze them further by methods of partial and multiple correlation.

### Components of Gait

The checks on all the analysis sheets of all the judges were tabulated on a master analysis sheet. Perusal of this sheet indicated that in the main the judges were in agreement as to the presence or absence of the various characteristic individual gaits, either three or four judges being in agreement on 72.01 per cent of the possible

choices. For further analysis only those characteristics for each individual were used on which a minimum of three judges had agreed. On the basis of the average gait grade the subjects were classified as good, medium, or poor in the following manner: A score of 5, 6, 7, was good; a score of 4 was medium; a score of 3, 2, 1, was poor.

Chi Square tables were set up to show the relationship of good, medium, and poor classifications to the incidence of the various characteristics listed on the analysis sheets. The significant Chi Squares are shown in Table III. From the table it is apparent that

TABLE II

INTERCORRELATIONS OF THE VARIABLES

| | 1. | 2. | 3. | 4. | 5. | 6. | 7 |
|---|---|---|---|---|---|---|---|
| Posture Grade | | | | | | | |
| Motor Test Score | .12±.07 | | | | | | |
| Motor Quotient | .02±.07 | | | | | | |
| Center of Gravity Erect | .03±.07 | —.03±.07 | —.10±.07 | | | | |
| Center of Gravity Supine | .20±.07 | .17±.07 | —.12±.07 | | | | |
| Center of Gravity Supine Height | .07±.07 | | | —.22±.06 | | | |
| Iliac Difference | | .02±.07 | —.08±.08 | | | | |
| Gait Grade | .27±.06 | .18±.07 | .22±.07 | —.15±.07 | —.15±.07 | —.01±.07 | .01±.07 |
| Mean | 12.41 | 244.93 | 96.34 | 46.94 | 35.99 | .55 | 4.20 |
| S.D. | 4.61 | 57.62 | 9.01 | 1.68 | 1.36 | .007 | .91 |

the characteristics which differentiate among good, medium, and poor gait are: relaxation, alignment, poise, position of the shoulders and elbows, position of the head, strength of push-off, pelvic inclination, leg swing from the hip. From a study of the Chi Square distributions, these appear to be related to good and poor gait as follows:

| GOOD GAIT | POOR GAIT |
|---|---|
| Relaxation of the body | Tenseness of the body |
| Good alignment of the body segments | Poor alignment of the body segments |
| Normal poise of the body | Backward poise of the body |
| Well balanced shoulders | Forward shoulders |
| Normal tension at the elbow joint | Tensed elbows |
| Head erect | Head forward |
| Strong push-off | Weak push-off |
| Normal pelvic inclination | Pelvic inclination tends to be decreased |
| Free leg swing from the hip joint | Restricted leg swing from the hip joint |
| Relaxed shoulders | Tensed shoulders |

To determine how well these items will identify the good and the poor gait in the individual, the check lists for the twenty-two girls classified as good and the thirty-three girls classified as poor were subjected to further examination. For each girl the number of desirable characteristics, the number of undesirable character-

TABLE III

CHARACTERISTICS SHOWING SIGNIFICANT RELATIONSHIPS WITH CLASSIFICATIONS OF GAIT

| View | Characteristics | Cases* | Chi Square | Significance |
|---|---|---|---|---|
| Side | General:<br>Relaxed<br>Tensed<br>Over-relaxed | 70 | 34.2153 | 1% |
| | Alignment:<br>Good<br>Fair<br>Poor | 69 | 74.8797 | 1% |
| | Poise:<br>Normal<br>Forward<br>Backward | 81 | 30.7020 | 1% |
| | Shoulders:<br>Well balanced<br>Retracted<br>Forward<br>Over-relaxed<br>Tensed | 75 | 77.4958 | 1% |
| | Elbows:<br>Normal<br>Tensed<br>Over-relaxed | 74 | 65.2717 | 1% |
| | Head:<br>Erect<br>Forward | 60 | 15.1315 | 5% |
| | Push-off:<br>Strong<br>Weak<br>Exaggerated | 62 | 17.0473 | 5% |
| | Pelvic Incl.:<br>Normal<br>Increased<br>Decreased | 72 | 15.2751 | 10% |
| | Hip Swing:<br>Free<br>Restricted | 75 | 11.8287 | 10% |
| Front and Back | Shoulders:<br>Relaxed<br>Tensed<br>Over-relaxed | 75 | 24.0144 | 1% |

* The number of cases varies because of the number of disagreements of the judges on the different characteristics. Cases showing disagreement were not used; only cases in which there was agreement of three or four judges' opinions were used to make the Chi Square analysis.

istics, and the number of significant items upon which the judges did not agree were tabulated. These are shown in Tables IV and V.

TABLE IV
GOOD GAIT CASES

| *Case No.* | *Desirable* | *Undesirable* | *Disagreement* | *Ratings* |
|---|---|---|---|---|
| 57 | 11 | 0 | 0 | 5, 5, 6, 6 |
| 12 | 10 | 0 | 1 | 6, 6, 6, 6 |
| 100 | 10 | 0 | 1 | 5, 5, 5, 5 |
| 5 | 10 | 1 | 0 | 5, 6, 6, 6 |
| 15 | 10 | 1 | 0 | 4, 6, 6, 5 |
| 24 | 10 | 1 | 0 | 6, 6, 5, 6 |
| 30 | 10 | 1 | 0 | 6, 6, 5, 6 |
| 21 | 9 | 0 | 2 | 6, 6, 6, 6 |
| 29 | 9 | 0 | 2 | 5, 6, 6, 6 |
| 38 | 9 | 0 | 2 | 3, 5, 6, 6 |
| 56 | 9 | 0 | 2 | 6, 5, 5, 5 |
| 103 | 9 | 0 | 2 | 6, 6, 7, 6 |
| 41 | 8 | 1 | 2 | 4, 5, 5, 6 |
| 14 | 7 | 0 | 4 | 5, 6, 5, 4 |
| 66 | 7 | 0 | 4 | 5, 5, 5, 5 |
| 58 | 7 | 1 | 3 | 6, 5, 4, 5 |
| 72 | 7 | 1 | 3 | 4, 5, 6, 6 |
| 16 | 7 | 2 | 2 | 4, 5, 6, 5 |
| 94 | 7 | 3 | 1 | 6, 4, 5, 5 |
| 11 | 5 | 1 | 4 | 4, 5, 5, 6 |
| 77 | 5 | 2 | 4 | 4, 7, 4, 6 |
| 4 | 5 | 4 | 2 | 5, 6, 5, 5 |
| Mean: | 8.23 | 1.58 | 2.41 | 5.36 |
| Range: | 5-11 | 0-4 | 0-4 | 3-7 |

## DISCUSSION

It is rather interesting to note that the only significant factor affecting the appearance of the walk (from the Chi Square analysis) in the forward and back views of the subject was the quality of movement of the shoulders. It is also interesting to note that the leg swing and the push-off are the only significant characteristics related to the lower extremities in the general appearance of the gait. These findings are in accord with those of the study done by Bass, who also demonstrated that there is good body alignment, a free leg swing from the hip, a strong push-off, and an erect carriage of the head in good gait; and that the head is forward, there is a weak push-off, and a tenseness of the body in poor gait.

It is likewise surprising that some of the characteristics such as pronation, pelvic tilt, pelvic twist, position of the leg during the swing, which are so closely allied to standing posture did not affect the judges' ratings of the walk more strongly than was indicated in the Chi Square analysis.

Although the movements and relative positions of the segments of the lower extremities were not found to be significant in the general appearance of the gait of an individual, it is the opinion

TABLE V
POOR GAIT CASES

| *Case No.* | *Desirable* | *Undesirable* | *Disagreement* | *Ratings* |
|---|---|---|---|---|
| 89 | 0 | 10 | 1 | 4, 2, 1, 2 |
| 8 | 0 | 9 | 2 | 2, 3, 3, 2 |
| 35 | 0 | 9 | 2 | 2, 2, 3, 2 |
| 45 | 1 | 9 | 1 | 4, 4, 4, 3 |
| 40 | 0 | 8 | 3 | 4, 2, 4, 2 |
| 54 | 1 | 8 | 2 | 4, 2, 3, 3 |
| 3 | 0 | 7 | 4 | 4, 4, 3, 2 |
| 17 | 1 | 7 | 3 | 4, 4, 3, 3 |
| 51 | 1 | 7 | 3 | 3, 2, 4, 2 |
| 68 | 1 | 7 | 3 | 4, 5, 4, 2 |
| 7 | 2 | 7 | 2 | 4, 5, 3, 3 |
| 10 | 2 | 7 | 2 | 4, 4, 3, 4 |
| 69 | 3 | 7 | 1 | 4, 3, 3, 3 |
| 91 | 0 | 6 | 5 | 2, 1, 1, 3 |
| 25 | 1 | 6 | 4 | 4, 4, 4, 3 |
| 27 | 1 | 6 | 4 | 4, 3, 5, 3 |
| 44 | 1 | 6 | 4 | 4, 3, 4, 4 |
| 106 | 2 | 6 | 3 | 3, 2, 4, 2 |
| 49 | 3 | 6 | 2 | 4, 3, 4, 4 |
| 85 | 4 | 6 | 1 | 4, 2, 2, 3 |
| 78 | 1 | 5 | 5 | 5, 4, 3, 3 |
| 93 | 3 | 5 | 3 | 3, 3, 5, 4 |
| 99 | 3 | 5 | 3 | 4, 2, 4, 3 |
| 55 | 4 | 5 | 2 | 4, 4, 3, 4 |
| 1 | 1 | 4 | 6 | 4, 5, 3, 3 |
| 104 | 2 | 4 | 5 | 3, 3, 3, 3 |
| 86 | 3 | 4 | 4 | 4, 4, 3, 4 |
| 88 | 1 | 3 | 7 | 5, 3, 4, 3 |
| 52 | 4 | 3 | 4 | 5, 4, 3, 2 |
| 76 | 4 | 3 | 4 | 3, 3, 3, 3 |
| 74 | 1 | 2 | 8 | 3, 3, 3, 3 |
| 107 | 3 | 2 | 6 | 4, 4, 2, 4 |
| 83 | 5 | 2 | 4 | 3, 4, 4, 4 |
| Mean: | 2.19 | 5.79 | 3.42 | 3.29 |
| Range: | 0-5 | 2-10 | 1-8 | 1-5 |

of this investigator that it is the reaction of the rest of the body to these movements which is more noticeable and therefore checked more often. Therefore in attempting to teach girls to walk well such factors as pronation, direction of foot and leg swing, tilt and twist of the pelvis should not be neglected in emphasizing the factors found to be more significant in this study. The latter factors are also ones in which improvement is readily discernible to the individual herself, which aids considerably in the teaching of body mechanics in walking.

A comparison of Tables IV and V shows that the components of good gait are more easily recognizable than the components of poor gait. The mean number of desirable characteristics for the good gait cases was 8.23 while the mean number of undesirable characteristics of poor gait was 5.79. The mean number of unde-

sirable characteristics in the good gait cases was 1.58 while the mean number of desirable characteristics in poor gait was 2.19. The mean number of disagreements on the good gaits was 2.41 and the mean number of disagreements on the poor gaits was 3.42. From inspection of these tables it might be concluded that the components of poor gait were more difficult to recognize than the components of good gait; since there was more disagreement among the judges on the poor cases than on the good cases. In some instances the judges' analyses of the gaits are not compatible with their gradings of the gait in respect to the poor cases. It is possible that the presence of two or three undesirable characteristics is sufficient to cause the entire gait to be rated as poor. The fact that competent judges agree only 72.01 per cent of the time on the presence or absence of certain characteristics in a gait is an indication of the lack of standardized criteria for judging gait, even among authorities.

## CONCLUSIONS

From the findings of this study it may be concluded that:

1. The correlations between the variables: gait grade, standing posture, motor ability, height of the center of gravity, location of the center of gravity in the antero-posterior plane, iliac difference, center of gravity/height, are so small that they have little practical predictive value.

2. Competent judges tend to agree in their observations concerning these components in the gait of an individual, but they tend to disagree more frequently on those individuals whose gaits are classified as poor.

3. Good gait is characterized by moderate relaxation of the body, good alignment of the body segments, normal poise of the body, well balanced and relaxed shoulders, normal tension in the elbow joint, erect carriage of the head, strong push-off, normal pelvic inclination, and free leg swing from the hip.

4. Poor gait is characterized by tenseness of the body, poor alignment of the body segments, backward poise of the body, forward and tensed shoulders, tensed elbows, forward head, weak push-off, decreased pelvic inclination, and restricted leg swing from the hip.

5. A good gait can be differentiated from a poor gait in terms of eleven components based on the movements and relationships of specific body segments, each of which components may be observed separately.

## APPLICATIONS TO TEACHING

These findings offer certain suggestions which might be used in a teaching program. In helping a student to improve the appearance of her walk, each of these items could be brought to her

attention, and she could be taught to observe these characteristics in her own gait. The progression suggested in teaching a student to improve her gait is: first, a consideration of the desired amount of relaxation of the body, and the methods of achieving it; second, instruction in the proper alignment of the body segments; and third, attention to the poise or tilt of the body as a whole, involving as it does the relation of the center of gravity to the base of support.

After these general relationships are fairly well established, the more specific points might be stressed one at a time, and attention could be focussed on shoulders, carriage of the head, the push-off, the pelvic inclination, and the leg swing. Later, lessons could be devoted to integrating these various aspects, the emphasis on each of them being determined by the individual needs of each student. At all times the major emphasis would be improved appearance, which is, psychologically, a good approach to the college girl.

While it is recognized that the present study is not the final answer to the problem of teaching people how to walk properly, it does suggest a specific type of approach which it is hoped may prove useful to the teacher of college women.

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# Evidence for a Science of Recreational Guidance

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MUCH has been said in the past about our new leisure. Prior to World War II much was said about the greatly increased amount of that leisure. Whatever the current revolution may bring, it is likely that we will have a return of the day of great amounts of leisure. But whether we are concerned about recreation as an antidote for war jitters or as conducive to post-war mental health and as a cure for the hangover from our international binge, recreation is destined to be one of our major social tasks. With our technological improvements, perhaps the quantity will take care of itself. But what can we do about its quality? Since, as has frequently been pointed out, science—physical science—has been responsible for a large quantitative increase in our leisure and will again be responsible for an even greater increase, is it too much to hope that science—this time, social science—will give us leisure improved qualitatively?

If, in the opinion of a recent authority on human relations, there is far more need for guidance in recreation than for vocational guidance, it becomes pertinent to inquire into the possibilities of scientific findings adequate for making such guidance possible. He who guides must possess a certain relevant body of knowledge and an effective set of instruments for use in making predictions. What are the possibilities that such knowledge and such instrumentation could result from scientific research in this direction?

The work of E. K. Strong and others in vocational measurement suggests that similar success in recreational guidance lies ahead of us. If there are objectively demonstrable differences (easily detectible by pencil and paper techniques) between the personalities of lawyers and doctors, are there not similar differences between those who engage in such a pastime as playing bridge and those who engage in such a pastime as tennis? Moreover, if we have been able to use these differences with some success in guiding people into appropriate vocations, that is, appropriate to the personality of the individual, should we not be able to guide people into appropriate avocations? In short, whatever can be said

with regard to the feasibility of vocational guidance can be suggested for the feasibility of avocational guidance.

In either case we deign to predict who will eventually go into an activity on the basis of the earmarks of those who have already gone in and stayed in. With such a prediction made sound, and assuming that those who do go in and stay in are those who ought to do so, we proceed to guide persons to the end that more and more those who go in are those who ought to go in, are glad that they went in, thank us for having got them in, and find therein maximal satisfaction and benefit. As more and more people go in who ought to go in, more and more accurately can we differentiate and say who ought to go in—predict who will stay in, and with what satisfaction.

The beginning can be made only if groups of individuals already participating with satisfaction can be made to reveal differentiating earmarks. As contrasted recreational groups can be found to show differential characteristics, we can hope for a science of recreational guidance; only insofar as these differences are found can there be hope for prediction. Any relationship, therefore, which can be shown to exist between any specific recreational practice or any general recreational tendency and any other personal facts or data raises our hopes for an eventual science of recreational guidance.[1]

The staff of the Character Research Institute, (during the past few months), has been experimentally and roughly correlating recreational preference indications with each other and with non-recreational personality items and scores. Some of the more incisive of these findings are here presented, both illustratively and statistically. Both types of data are presented in answer to the question: Do measurable relations exist between a particular recreational tendency and other personality variations?[2]

The data here presented have been derived from a larger set of data based on the reactions of 750 persons to thirteen sections of the Youth Expressionaire, a fifty-seven page instrument devel-

[1] To be more concretely explicit, if conservative personalities more often prefer to listen to sports broadcasts, and radical personalities more often prefer to look for constellations, and if card players are more often those who say they like to read movie and true story magazines, and non-card players more often like to listen to scientific lectures, then, along with other symptoms, conservative and radical tendencies can be used in the prediction, respectively, of sports and stellar recreation, and reading movie and true story magazines and listening to scientific lectures can be used to predict the probability or improbability of satisfaction at cards.

[2] In the data here presented, there are two assumptions: (a) that recreational preference is highly related to recreational practice; (b) that pencil and paper symptoms of either the preference for or the practice of a particular activity constitute a highly economical type of earmark and that there are relationships among data thus obtained which will transfer, to a useful degree, to the facts otherwise secured.

oped by the Character Research Institute for the purpose of determining interests, attitudes, opinions, and preferences. Included in these thirteen sections were three pertaining, for the most part, to recreational activities; one, a list of eighty-four major recreational activities in connection with which the subject was asked to check L, I, or D to indicate his liking, indifference, or dislike; the second, a list of 192 minor activities, more or less recreational, to be reacted to in the manner just described; and the third, a list of 108 book titles with provision for checking R, WR, or D to indicate whether the subject had read the book and liked it, would like to read it, or had read it and disliked it.

The results will be shown in two parts. Section I presents findings made when we take as our reference point a personality score originally evolved without reference to recreation and attempt to find the recreational correlates thereof. Section II presents findings made when we take as our reference point a particular recreation or type of recreation and hunt for the correlates, either recreational or non-recreational, thereof.

## SECTION I

### Recreational Differences Between Non-Recreational Groups

Table I, following, presents illustrations of recreational items which appear to have substantial relationship with the personality trait scores of Conservatism,[3] Internationalism, Happiness, and Minority-mindedness.[4] In the case of each of these traits, scores were obtained from batteries of opinionaire and questionnaire items. The method used for correlating was as follows. For each variable there were chosen, from 389 cases, the one hundred, approximately one-fourth, persons receiving the highest scores, and their reactions in terms of percentages were compared with the reactions of the one hundred persons receiving the lowest scores. The high score people are always referred to as the "U" group, and the low score people as the "L" group.

The figures for each item are to be interpreted as the number

[3] The Conservatism score was based upon 116 items included in the Youth Expressionaire and taken from the C-R Opinionaire, Forms J and K, developed by the Character Research Institute.

[4] The term, "Internationalism," is here used to designate a tendency to react to items in a way which indicates that the individual has a world-wide point of view in contrast to "Nationalism," a tendency to react from the point of view of his own particular national sphere. Scores were based on 115 items picked by a jury for their apparent relation to matters of international and national concern.

Happiness scores are based on similarly jury-chosen set of items relating to happiness as it is generally conceived.

Minority-mindedness is used to designate the tendency to react to items in a manner directly opposite to that of the majority of the population, i.e., to items to which the majority of the population responds affirmatively, the minority-minded person responds negatively; to items to which the majority of the population responds negatively, the minority-minded person responds positively.

TABLE I*

ILLUSTRATIVE RECREATIONAL DIFFERENCES BETWEEN CONTRASTED PERSONALITY GROUPS

| Per Cent of U Group Responding Affirmatively | Per Cent of L Group Responding Affirmatively | Per Cent Difference | Item |
|---|---|---|---|
| | Conservatism (U)—Radicalism (L) | | |
| 62 | 28 | 34 | Like to listen to drama and adventure stories on the radio |
| 79 | 45 | 34 | Like to watch a circus |
| 81 | 57 | 24 | Like to go to a parade |
| 23 | 59 | —36 | Like to argue during social calls |
| 19 | 54 | —35 | Read and liked *Microbe Hunters* |
| 15 | 43 | —28 | Like to listen to a political speech |
| | Internationalism (U)—Nationalism (L) | | |
| 69 | 38 | 31 | Like to read poems |
| 72 | 43 | 29 | Like to watch ants build an ant hill |
| 60 | 32 | 28 | Like to look for constellations |
| 37 | 63 | —26 | Like to do crossword puzzles |
| 46 | 69 | —23 | Like to play card games |
| 61 | 84 | —23 | Like to attend football games |
| | Minority-Mindedness (U)—Majority-Mindedness (L) | | |
| 47 | 24 | 23 | Dislike to collect butterflies |
| 59 | 38 | 21 | Like to ride horseback |
| 47 | 26 | 21 | Dislike to classify wild flowers |
| 60 | 85 | —25 | Like tc read non-fiction |
| 39 | 64 | —25 | Like to read women's and men's magazines |
| 52 | 76 | —24 | Like educational radio programs |
| | Happiness (U)—Unhappiness (L) | | |
| 80 | 56 | 24 | Like to entertain others |
| 66 | 43 | 23 | Like to read scientific magazines |
| 52 | 30 | 22 | Like to play golf |
| 30 | 55 | —25 | Like to gossip with a friend |
| 22 | 44 | —22 | Like to sleep during the day |
| 25 | 39 | —14 | Like to overhear an argument |

* The small number of items reported here is not sufficient to give a clear picture of the general trend. The reader must remember that throughout this article the data are chosen with respect to one question—"Can relationships be located between a recreational preference on the one hand and any other symptom of personality on the other?"

of each group responding to the item as stated. For instance, for the first item under Conservatism-Radicalism in Table I, noting the figures in the first, second, and third columns, respectively, we see that 62 per cent of the one hundred most conservative members of our population indicated that they like to listen to drama and adventure stories on the radio, while 28 per cent of the least conservative, that is, the most radical, of the same original group of 389 persons indicated that they liked that recreation. This gives us

a difference of 34 per cent between the two groups, which becomes the measure of the degree of relationship between our Conservatism-Radicalism score and this particular recreational item. Passing to the fifth item, we note that only 19 per cent of the conservative indicate that they have read and liked *Microbe Hunters* by De Kruif, as against 54 per cent of the radicals, giving us a difference of —35, and indicating a negative relationship between conservatism on the one hand and the tendency to read *Microbe Hunters* on the other.

In the second set of items, we find that 69 per cent of the one hundred internationalists indicate that they like to read poems, but only 38 per cent of the nationalists do so, giving a difference of 31 per cent and indicating a positive correlation between the tendency to like to read poems and the tendency to score high on our test for internationalism. On the other hand, noting the fourth item in this part of Table I, only 37 per cent of the internationalists indicate a liking for crossword puzzles as against 63 per cent of the nationalists, giving a difference of —26 and indicating a negative correlation between internationalism on the one hand and crossword puzzles on the other.

Passing to the trait of minority-mindedness, on the first item, 47 per cent of the minority-minded and 24 per cent of the majority-minded indicate that they dislike to collect butterflies, a difference of 23 per cent which shows a positive correlation between minority-mindedness and aversion to this pastime. On the fourth item 60 per cent of the most minority-minded persons indicate a liking for reading non-fiction, whereas 85 per cent of the majority-minded indicate a preference for this type of activity. This gives a difference of 25 per cent, showing a negative correlation between minority-mindedness as here measured and preference for reading non-fiction.

The first item in the section pertaining to the trait of happiness shows that 80 per cent of the happiest persons, according to the measure used, indicated that they like to entertain others, while only 56 per cent of the least happy persons indicated a liking for this activity. This gives a difference of 24 per cent and indicates a positive correlation between happiness and liking to entertain. On the other hand, 30 per cent of the happiest and 55 per cent of the least happy persons indicate that they like to gossip with a friend, the fourth item in this happiness list. This difference of —23 indicates a negative correlation between happiness and liking to gossip.

These figures lead to the tentative conclusion that personality differences, measured by way of non-recreational responses, have a definite relationship with responses to recreational items. For instance, with regard to the first trait, it would appear that there is such a thing as radical, contrasted with conservative, recreation,

and that perhaps conservatives and radicals should be guided towards different recreational activities. Similarly, with regard to the recreational preferences and the recreational guidance of the nationalists and the internationalists, the more or less minority-minded, and the more or less happy. It would seem that important discoveries are ahead of us with respect to these relationships as we attempt to answer further the question as to the why of these differences and relationships.

The data in Table I are presented by way of illustration. There is still the question as to whether these differences may not be due to chance. To answer this question Table II is presented, showing the percentages of items found which differentiate the respective groups by percentage differences equal to at least twice the standard error of the difference.

TABLE II

SUMMARY OF RECREATIONAL DIFFERENCES BETWEEN CONTRASTED PERSONALITY GROUPS

| | Per Cent of Significantly Differentiating Items | | | |
|---|---|---|---|---|
| | 84 Major Activities Liked | 192 Minor Activities Liked | 108 Books Read | Total Including All Types |
| Conservatism—Radicalism | 33.3 | 27.1 | 42.6 | 32.8 |
| Internationalism—Nationalism | 29.8 | 25.0 | 21.3 | 25.0 |
| Minority-Mindedness—Majority-Mindedness | 21.4 | 18.9 | 7.4 | 16.1 |
| Happiness—Unhappiness | 13.1 | 13.6 | 10.2 | 18.4 |
| Average for all groups | 24.4 | 21.1 | 20.4 | 21.9 |

This table is to be read as follows. Out of eighty-four major activities, such as sports, radio programs, movies, etc., twenty-six items, or 33 per cent, showed a difference at least twice the standard error of the difference between the percentage of conservatives and the percentage of radicals indicating their liking. Out of 192 minor activities, such as entertaining, doing jig-saw and crossword puzzles, shooting quail, etc., fifty-two items, or 27 per cent, showed a difference at least twice the standard error of the difference. Among the 108 book titles, there were found forty-six, or 42 per cent, which showed as large a difference. For all three sections the number of such differentiating items for the conservatives and the radicals was 130, or 32.8 per cent. Figures on the other groups are to be interpreted similarly. For all four contrasts, the average percentage of significantly differentiating items among the eighty-four major activities is 24.4, among the 192 minor activities, 21.1, and among the 108 books, 20.4 per cent. The number for all groups for all activities is 21.9 per cent.

These figures are quite impressive in view of the fact that our standard statistical tables have led us to expect 4.4 per cent of such items to show differentiation by this much by sheer chance. The difference between 4.4 per cent and 21.9 per cent may be taken as the most probable measure of the extent of the percentage of all recreation items showing relationship with these four personality traits. There thus seems to be an abundance of items in the recreational lists which are found to correlate with these personality scores.

## SECTION II

### Recreational Differences Between Recreational Groups

Having searched for relationships by starting with general personality traits, generally measured, and seeking their recreational correlates, we turn next to the opposite approach and try to locate the correlates of specific recreation items or groups of recreation items, in order to answer the question: Are pencil and paper correlates of specific recreation preferences discoverable? This question will be considered in two parts: (a) when these recreational preferences are considered individually, and (b) when they are considered in clusters.

The first aspect has to do with those who indicate "like" in contrast to those who indicate "dislike" of a certain single activity. Putting the matter more concretely, our question here becomes: Do those who like to play poker differ appreciably in their preference for other activities from those who do not like to play poker? Table III, on the following page, gives illustrative answers to this question for poker players and also for chess players, stamp collectors, and those who like to argue.

The figures in Table III are to be read as follows. Referring to the first item concerning poker players, 45 per cent of the players indicate that they like to lag pennies, as shown in Column 1, whereas only 17 per cent of the non-poker-players indicate that they like this activity, as shown in Column 2, giving a difference, as shown in Column 3, of 28 per cent, and so on for the other items in this group. Figures for the other groups are to be read similarly except as they refer to chess players, stamp collectors, or persons who like to argue.

It will be noted that there is a general element of "L-ness" or "like-ness" which seems to run through all of these differences; generally speaking, the people who like to play poker, like to play chess, like to collect stamps, like to argue, and like more things than the people who dislike these activities. This suggests probably the wisdom of making an effort to modify or find a substitute for the "L-I-D" technique, which has been too long taken for granted. However, there seems to be, even aside from this tendency, variation with regard to the things liked.

TABLE III

ILLUSTRATIVE RECREATIONAL DIFFERENCES BETWEEN CONTRASTED RECREATIONAL GROUPS

| Per Cent of L Groups* Responding Affirmatively | Per Cent of D Groups* Responding Affirmatively | Per Cent Difference | Activity |
|---|---|---|---|
| Poker Players (L)—Non Poker Players (D) | | | |
| 45 | 17 | 28 | Like to lag pennies |
| 81 | 63 | 18 | Like to go dancing |
| 84 | 66 | 18 | Like to visit a carnival |
| 45 | 71 | —26 | Dislike to smoke a pipe |
| 22 | 40 | —18 | Dislike to play bridge |
| 25 | 42 | —17 | Dislike to play chess |
| Chess Players (L)—Non Chess Players (D) | | | |
| 61 | 38 | 23 | Like to run a race |
| 82 | 63 | 19 | Like to play baseball |
| 78 | 60 | 18 | Like to go on field trips |
| 32 | 54 | —24 | Dislike to collect butterflies |
| 33 | 53 | —20 | Dislike to play poker |
| 21 | 40 | —19 | Dislike to play mumblepeg |
| Collectors (L)—Non Collectors (D) of Postage Stamps | | | |
| 40 | 14 | 26 | Likes to collect antique furniture |
| 72 | 49 | 23 | Like to go to big league ball games |
| 52 | 31 | 21 | Like to carve soap |
| 9 | 29 | —20 | Dislike to go trout fishing |
| 57 | 76 | —19 | Like to visit a carnival |
| 11 | 27 | —16 | Dislike to fly a kite |
| Arguers (L)—Non-Arguers (D) | | | |
| 37 | 18 | 19 | Like to criticise amateur poems or plays |
| 56 | 42 | 14 | Like to organize clubs |
| 59 | 46 | 13 | Like to read long books |
| 29 | 51 | —22 | Dislike to play poker |
| 44 | 64 | —20 | Dislike to repair an auto |
| 22 | 39 | —17 | Dislike to play chess |

*In each of the four sections above, the L and D groups consist respectively of those who indicate like and dislike for the recreation represented. The members of these contrast sub-groups vary in number from one to three hundred persons.

The data in Table III, as were those in Table I, are presented by way of illustration. And again, a summarization is presented, this time in Table IV, in answer to the question as to whether these differences may be due to chance. In Table IV are presented the percentages of items found which differentiate the respective groups by percentage differences at least twice the standard error of the difference.

Table IV is to be interpreted as follows. Out of 120 items representing minor recreational activities, twenty-seven, or 23 per cent, showed a difference between those who like to play poker and those who do not of at least twice the standard error of the dif-

TABLE IV

SUMMARY OF RECREATIONAL DIFFERENCES BETWEEN CONTRASTED RECREATIONAL GROUPS

| Contrast Groups* | Per Cent Significantly Differentiating Items 120 Minor Activities |
|---|---|
| Play poker | 23 |
| Play chess | 36 |
| Collect stamps | 34 |
| Argue | 20 |

* Each activity listed represents two contrasted groups, those who indicated that they liked the activity, and those who indicated that they disliked the activity.

ference. The other three figures are to be interpreted similarly for the activities to which they refer.

The second aspect of the search for the recreational correlates of recreational preferences, namely, when the recreational preferences are considered in a cluster is illustrated in Table V by the differences between what we have termed "venturesome" and "non-venturesome" persons. Each person in the population was given a score representing the number of activities for which he expressed a preference on a list of twenty-one recreations[5] most of which apparently require some daring or afford seemingly more than usual excitement. Each group was composed of one hundred persons, approximately equal numbers of men and women in each, the venturesome group including those with the highest scores on the twenty-one items, and the non-venturesome group, those with the lowest scores.

TABLE V

ILLUSTRATIVE RECREATIONAL DIFFERENCES BETWEEN VENTURESOME AND NON-VENTURESOME GROUPS

| Per Cent of Venturesome Group Responding Affirmatively | Per Cent of Non-Venturesome Group Responding Affirmatively | Per cent Difference | Activity |
|---|---|---|---|
| 87 | 40 | 47 | Like to visit a steel mill |
| 63 | 22 | 41 | Like to attend a murder trial |
| 54 | 17 | 37 | Like to go frog hunting |
| 2 | 29 | —27 | Dislike to play golf |
| 31 | 56 | —25 | Dislike to attend a burlesque show |
| 24 | 51 | —27 | Dislike to attend a boxing or wrestling match. |

[5] These activities are: own a race horse, visit a carnival, run a locomotive, do a parachute jump, see a forest fire, swim the English Channel, go dancing, go slumming, visit a fortune teller, climb fences, be a war hero, go to a circus, visit an insane asylum, hitch hike, climb a mountain, be in a big crowd, run a race, be a racing jockey, visit Africa, play golf, and play mumblepeg. These were subjectively chosen by Hollerith Operator Robert Randel on the basis of apparently common correlations.

The data in Table V are to be interpreted as follows. Referring to the first item, 87 per cent of the venturesome group indicated that they like to visit a steel mill, whereas only 40 per cent of the non-venturesome group indicated a similar preference. Looking at the fifth item, 31 per cent of the venturesome group and 56 per cent of the non-venturesome group indicate that they dislike burlesque shows. The differences between the two groups on these two items, 47 and —25, respectively, present tentative evidence of a positive correlation between liking venturesome activities and liking to visit a steel mill, and a negative correlation between liking venturesome activities and disliking burlesque shows.

Out of eighty-four major activity items, fifty-one, or 61 per cent, showed a difference of at least twice the standard error of the difference. Out of seventy-two minor activity items, forty-eight, or 67 per cent showed this large a difference. From this, and from the data presented in Tables III, IV, and V, we conclude that it is possible, on the basis of expressed liking for or dislike of specific recreational activities or certain clusters of recreational activities, to predict other recreations which would be satisfying to the person expressing his preference.

It will be noted that in this section, which deals with the correlates of recreational preference, the only correlates reported are other recreational preferences. Many other correlates of a non-recreational nature have been found and will be reported in future articles.

## SUMMARY

It has been suggested that, since physical science has increased the quantity of leisure, it would seem fitting to have social science improve its quality, and that, recreational guidance comparable to vocational guidance is important and desirable.

That such avocational guidance is possible is borne out to some extent by the data yielded by this study. Belief in the possibilities of a science of recreational guidance is advanced by the appearance of reliable relationships among human behaviors, including recreational ones. This investigation has revealed an abundance of crude, but significant, correlations between recreational preferences and non-recreational symptoms and other recreational symptoms, which can be assumed to be, at least partially, representative of a very large mass of relationships yet to be revealed.

Specific recreational preference appears to be a function of highly generalized features of personality symptomized by non-recreational as well as a wide array of recreational, earmarking characteristics. It seems, therefore, that the road is wide open for pursuing further research hopeful of findings basic to an eventual program of recreational guidance.

Further work to be done along these lines is suggested by the following questions:

1. What further correlations can be found?
2. From what reference point can the correlations best be sought?
   a. Should the various recreation items be factored or clustered?
   b. Should personality factoring or analysis be first furthered, and these factors used as the reference or starting points?
3. By what techniques should the recreational preferences or tendencies of individuals be determined?
   a. What distortions or defects inhere in the L-I-D technique? Is there a general tendency for some subjects to check L's more often? Is this tendency itself a personality variable? If so, what is its meaning? Does this tendency distort the measurement of other variables? If so, how can it be corrected?
   b. How can intensity of interest be indicated?
   c. Would a ranking technique give additional data including the factor of intensity?
4. Are there generalized personality traits heretofore otherwise measured and unmeasured which can be measured through the medium of recreational preferences, viz., introversion-extroversion, conservatism-radicalism, dominance-submission?
5. Is a declaration of preference more or less sound as a reference point than a declaration of practice?
6. What "lost motion" is there between pencil and paper symptoms and the realities as determined by any other more valid procedure?
7. After correlations are discovered, what will constitute the most adequate arrangement into predictive instruments?

Recreation has never, due to our puritan heritage, had just and due consideration, and least of all at the hands of science. As a result of the scientific, not to say naturalistic, trend in our philosophy, the time has come for hope in a new attitude of realism toward recreation. The time is at hand to act—to apply the scientific method.

# The Determination of the Weight and Size of a Standard Discus for College Women

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THE dimensions and weight of the official discus for college men have been described for years. It was only in 1938 that an implement was scientifically developed for high school boys. At the present time, the discus officially approved for women is incompletely defined. In addition, the measurements and weight required by the official rules lack scientific background, as far as we have been able to find.

The women's discus is described officially only in terms of diameter (7.56 ins.) and weight (2 lbs., 3¼ ozs.). In cases of all other officially approved implements, they are described, not only in terms of diameter and weight, but also as to thickness at the center, thickness ¼" from the rim, and diameter of the flat core.

It is logical to assume that the most suitable implement for women, should have the same weight-size relationship to the size and strength of women as the official men's discus bears to the size and strength of men. If such relationships exist, then records made by college men, high school boys, and college women are comparable on the basis of raw scores. If the implements are adjusted to the strength and size of each group, then distance thrown will vary according to ability. It is the purpose of this investigation to adjust the size and weight of the discus to the size and strength of women.

As a starting point, it is assumed that the collegiate discus is suitable for college men. As far as we know, no one questions this premise. The objective, then, is to adjust the discus in size and weight in proportion to the size and the strength of college men and college women.

The experimental procedure was to collect data from a representative group of college women, relative to their size and strength. The women selected were physical education majors, all of them having had experience in various sports, and practically all of them having had experience in discus throwing. It was unnecessary to collect original data from college men since these were already available.[1] However, precautions were taken so that the pro-

[1] W. W. Tuttle, Geo. T. Bresnahan, and Henry Canine, "Designing The New High School Discus," *Scholastic Coach*, 7 (April, 1938) 39, 40.

cedures used in collecting data from college women were like those used in the case of college men.

Data were collected from a group of seventy college women consisting of 12 graduate students, 12 seniors, 15 juniors, 16 sophomores, and 15 freshmen. The men's group from which the data were collected included 16 seniors, 27 juniors, and 27 sophomores.

A strength index was determined for each subject which included the sum of the individual's leg strength, back strength, right and left grip strength, chest-pull strength, chest-push strength, and finger-pull strength. The dynamometer was used for measuring strength in each case.

Finger strength was defined as the breaking force at the first joint of the second, third, fourth, and fifth digits. To get this strength, a hand dynamometer with a push-and-pull attachment was employed. One end of the attachment was fastened to a wall about shoulder high for the individual seated on the floor in front of it. The subject grasped the free end of the attachment with the first joint of the second, third, fourth, and fifth digits. The other joints of the fingers were extended as much as possible. By bracing herself with her feet against the wall she pulled until her grasp was broken. The dial on the dynamometer registered the breaking strength in pounds.

In the cases of other strength measurements, standard equipment was used, and the measurements were made in the orthodox manner.

A size index was determined from hand measurements taken from tracings of the throwing hand. These were made by placing the hand and forearm on a table with the hand and forearm in a straight line. The styloid processes of the forearm were marked, and the outline of the subject's hand traced on the back of her record sheet. Care was taken to keep the pencil perpendicular to the tracing surface at all times. The length of the hand was taken as the distance from the mid-point of a line joining the styloid processes of the forearm to the tip of the middle finger.

In measuring width, a line of best fit was drawn along the second metacarpal bone as a point of origin. The width was then taken as the greatest distance between the second and fifth metacarpal bones in a straight line perpendicular to the line measuring the length of the hand. These measurements were taken in centimeters and then changed into inches after the averages were computed.

On the basis of mean scores obtained, indices were established as shown in Table I.

Since the weight and size of the collegiate discus is recognized as suitable to the strength and to the size of college men, it follows that the college women's discus should be changed so that its size and weight bear the same relationship to the college woman. The

TABLE I

MEAN MEASUREMENTS OF 70 COLLEGE MEN AND 70 COLLEGE WOMEN

| | College Men | College Women |
|---|---|---|
| Leg strength (lbs.) | 595.9 | 439.2 |
| Back strength (lbs.) | 425.0 | 225.2 |
| Right grip strength (lbs.) | 131.0 | 90.3 |
| Left grip strength (lbs.) | 125.0 | 84.1 |
| Chest pull strength (lbs.) | 103.2 | 73.4 |
| Chest push strength (lbs.) | 121.6 | 69.3 |
| Finger strength (lbs.) | 145.5 | 75.2 |
| Strength index (lbs.) | 1648.0 | 1056.7 |
| Width of hand (in.) | 3.8 | 3.3 |
| Length of hand (in.) | 8.0 | 7.2 |
| Size index (in.) | 11.8 | 10.5 |
| Height (in.) | 71.3 | 64.1 |
| Weight (lbs.) | 178.3 | 132.9 |
| Age (years) | 20.5 | 20.9 |

following calculations show the modifications of the collegiate men's discus necessary to establish such a relationship.

*Weight calculations.*—The following proportion states the relationship between the mean strength indices of the two groups and the weights of the discuses:

$$\frac{\text{Strength index (men)}}{\text{Strength index (women)}} = \frac{\text{weight (men's discus)}}{\text{weight (women's discus)}}$$

In which
Strength index (college men) = 1648.0 lbs.
Strength index (college women) = 1056.7 lbs.
Weight (men's discus) = 4.4 lbs.
Weight (women's discus) = X lbs.
Substituting these values in the above equation we have:

$$\frac{1648.0}{1056.7} = \frac{4.4}{X}$$

X = 2.82 lbs. (weight of college women's discus)

*Diameter calculations.*—The relationship between the size of the hands of college men and college women and the diameters of the discuses may be stated:

$$\frac{\text{Length + width (men)}}{\text{Length + width (women)}} = \frac{\text{Diam. (men's discus)}}{\text{Diam. (women's discus)}}$$

in which
Length of hand (men) = 8.0 in.
Width of hand (men) = 3.8 in.
Length of hand (women) = 7.2 in.
Width of hand (women) = 3.3 in.
Diameter (men's discus) = 8.62 in.
Diameter (women's discus) = X
Substituting in the above equation we have:

$$\frac{8.0 + 3.8}{7.2 + 3.3} = \frac{8.62 \text{ (inches)}}{X \text{ (inches)}}$$

X = 7.67 inches (diameter of the college women's discus)

*Thickness calculations (center).*—The relation between the thickness of the discuses at their centers and one inch from their centers and the size of the hand of the two groups is stated as:

$$\frac{\text{Length + width (men)}}{\text{Length + width (women)}} = \frac{\text{Thickness (men's discus)}}{\text{Thickness (women's discus)}}$$

In which
Length of hand (men) = 8.0 in.
Width of hand (men) = 3.8 in.
Length of hand (women) = 7.2 in.
Width of hand (women) = 3.3 in.
Thickness (men's discus) = 1.75 in.
Thickness (women's discus) = X
Substituting in the above equation we have:

$$\frac{8.0 + 3.8}{7.2 + 3.8} = \frac{1.75 \text{ (inches)}}{X}$$

X = 1.56 inches (thickness of college women's discus at center)

*Thickness calculations (rim).*—The relation between the thickness of the discuses, (¼ inch from their rims) and the size of the hands of average college men and college women is expressed as:

$$\frac{\text{Length + width (men)}}{\text{Length + width (women)}} = \frac{\text{Rim thickness (men's discus)}}{\text{Rim thickness (women's discus)}}$$

In which:
Length of hand (men) = 8.0 in.
Width of hand (men) = 3.8 in.
Length of hand (women) = 7.2 in.
Width of hand (women) = 3.3 in.
Thickness ¼ in. from rim (men's discus) = .50 inches
Thickness ¼ in. from rim (women's discus) = X inches
Substituting in the above equation we have:

$$\frac{8.0 + 3.6}{7.2 + 3.3} = \frac{.50 \text{ inches}}{X \text{ inches}}$$

X = .44 inches (rim thickness of college women's discus)

Table II gives a comparison of the dimensions and weight of the discus which is now accepted as official with the dimension and weight of a discus proposed as being scientifically fitted to college women.

TABLE II

| | Present discus | Proposed discus |
|---|---|---|
| Diameter | 7.56 in. | 7.67 in. |
| Thickness (center) | ? | 1.56 in. |
| Thickness (rim) | ? | .44 in. |
| Weight | 2 lbs., 3¼ ozs. | 2 lbs., 13⅛ ozs. |

## CONCLUSIONS

On the basis of measurements of strength and size, a discus for women is described. The dimensions and weight of the women's implement should be as follows:

| | |
|---|---|
| Diameter | 7.67 in. |
| Thickness at center | 1.56 in. (1½ in.) |
| Thickness ¼ in. from rim | .44 in. |
| Weight | 2.82 lbs. (2 lbs. 13⅜ ozs.) |

As the present official discus for college women is described, they are throwing an implement which is too small and too light for their size and strength.

In addition, the dimensions at the center, and one-fourth inch from the rim are established.

# A Comparative Study of Physical Fitness Indices as Measured by Two Programs of Physical Education: The Sports Method and the Apparatus Method

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## STATEMENT OF THE PROBLEM

THE problem was a comparative study of physical fitness indices as measured by two programs of physical education: the sports method and the apparatus method. Essentially the study was twofold in nature: (1) it was concerned with measuring each individual's physical fitness in terms of the tests selected, at three different periods during the experiment; (2) of taking these differences for each method and comparing them with each other for improvement and rate of change.

## HISTORICAL BACKGROUND OF THE PROBLEM

An exhaustive survey of experiments in physical fitness disclosed the fact that few studies have been directed toward determining the superiority of one method over others for a superior method of attaining physical fitness. Furthermore there were no two individuals agreeing as to what physical fitness was, how to measure it, or which method was superior for achieving physical fitness. Hence the present study was undertaken in order to furnish experimental evidence which might clarify the issue and enable one to say with greater assurance than exists at present that physical fitness can, or cannot, be improved by using one of the above-named methods.

## PROCEDURE

### The Experimental Groups

The subjects used in this investigation consisted of three hundred and sixty-six male freshmen students in the required physical education classes of the College of the City of New York. Every student who registered for the first term in Hygiene and who was assigned by the Registrar to Hygiene 1B or 1C was tested. The groups were heterogeneous from the point of view of socio-economic status, nationality, intelligence, attitude, and interest in physical education, but were relatively homogeneous with respect to the

number of years of school experience. Moreover, all subjects who had outside athletic interests, who had incurred over four absences during the experiment or who were physically unfit were excluded from the experiment.

### The Methods Involved in the Program

The importance of attaining physical fitness was accorded due recognition. However, the most efficacious method for its achievement remained a debatable subject. The investigation established the relationship between two methods of accomplishing physical fitness: the apparatus method, and the sports method.

In this thesis the term, "apparatus method," referred to a formalized program consisting of equal amounts of work on the following pieces of equipment: parallel bars, tumbling mats, climbing ropes, horizontal ladder, Swedish vaulting box, side horse, horizontal bars, and the rings.

The term, "sports method," in this study embraced a program of instruction and participation in all of the following activities: boxing, wrestling, track and field, soccer, and swimming.

### Selection of the Test Battery

The tests selected to measure the various elements underlying physical fitness were taken from Cozens' classification of tests in terms of their predominant characteristics.[1] The test battery consisted of seven items: arm and shoulder-girdle strength was measured by the number of chins on the horizontal bar and the number of dips on the parallel bars; arm and shoulder-girdle coordination was measured by the baseball throw for distance; leg and jumping strength or power was measured by the jump and reach test; the quarter-mile run was used as an index of endurance or sustained effort; body coordination, agility, and control were measured by the bar snap for distance; and speed and drive of the legs were measured by the dodging run.

### Collection of Data

The raw scores for the seven tests given three times during the experiment were recorded by the examiners upon forms used to record scores at the City College. These scores were then transferred to each student's individual record card specifically prepared for recording these data.

### TREATMENT OF DATA

The data were analyzed from the point of view of determining the degree to which the variable, physical fitness, was affected by the experimental programs. In order to adequately demonstrate

[1] F. W. Cozens, *The Measurement of General Athletic Ability in College Men* (Eugene, Oregon: University of Oregon Press, 1929).

any changes that occurred in physical fitness status several statistical techniques were examined; the chi-square technique, correlation analysis, and critical ratio. The first two techniques were eliminated for the following reason, namely, that the present investigation was interested in the gross picture of the effectiveness of the two experimental programs. The critical ratio was found to be the most effective means for proving group differences.

In order to determine whether both groups were comparable at the beginning of the experiment frequency distributions for all test items were constructed for both experimental groups. Means, standard deviations, and critical ratios between means were then computed.

Both groups were again examined at the middle of the experiment and at the conclusion of the semester.

## THE RESULTS

By use of critical ratios the mean scores of the sports method group and the apparatus method group were compared with respect to total physical fitness at three periods during the experiment. The two groups were found to be similar with respect to total physical fitness, at the initial test administration (C.R. .13). The two groups appeared similar at the second test administration in total physical fitness since a critical ratio of .94 was not a significant difference. The sports method evidenced significant superiority in total physical fitness over the apparatus method for the last half of the experiment (C.R. 5.96).

The investigator analyzed each of the test items making up the battery during each of the three testing periods. The critical ratio of difference between means was used as indication of superiority of one group over the other.

Inspection of Table 1* indicates that the apparatus and sports groups were approximately equal in leg and jumping strength at the initial test administration. The results of the second test administration indicated that the two groups had improved about the same since the established critical ratio of 1.19 was not significant (Table II). Moreover the two groups continued to show approximately equal improvement since the critical ratio of difference between means at the third test administration was not significant (Table III). Hence it was apparent that neither group was superior to the other in improving jumping or leg strength.

Both groups appeared similar at the initial test administration in arm and shoulder-girdle coordination (C.R. 1.84). At the end of the second test administration both groups appeared to be even

* Tables will be found at end of article.

more similar since the critical ratio of .58 was smaller than that of the first test administration. The results of the third test administration indicated that there was no significant improvement of one group over the other for the last half of the experiment (see Table III). Hence it should be noted that there was no significant superiority shown by either method for improving arm and shoulder-girdle coordination for the entire experiment.

The apparatus method class and the sports method class appeared to be similar at the initial test administration in endurance since the critical ratio of difference between means was not significant (see Table I).

The similarity of the two groups remained evident throughout the entire experiment since the critical ratio of .59 at the second test period, and 1.85 at the final test period did not indicate any significant superiority for the sports method. Hence it was evident that neither group was superior to the other for improving endurance for the entire experiment.

The two groups were found to be similar in body coordination, agility, and control at the initial test administration. By the second test administration a significant superiority was evidenced by the sports method (see Table II). The results of the third test administration further indicated the superiority of the sport method over the apparatus method (Table III).

The speed of legs of both groups was determined to be similar at the initial test administration (Table I). However the apparatus method evidenced a significant superiority at the end of the second test administration (C.R. 3.13). The final administration of the test found the two groups once more equal since the critical ratio was insignificant (Table III). It was apparent that the sports group must have improved greatly during the last half of the experiment in order to make the difference between means at the conclusion of the test period insignificant. Hence neither group manifested superiority in improving speed of legs for the entire experiment.

The arm and shoulder-girdle strength of both groups as measured by chinning and dipping, was evidenced to be similar at the first administration of the test battery (see Table I). The sports method evidenced significant superiority over the apparatus method in chinning at the end of the second test administration (Table II). No significant difference showed between groups in the dipping test since a critical ratio of 1.67 is not taken as indicating significant difference. The sports method evidenced a reliable superiority over the apparatus method in chinning at the third test administration (see Table III). The sports method evidenced significant superiority over the apparatus group in dipping during the same period

(C.R. 3.59). It was evident that the improvement of arm and shoulder-girdle strength was superior in the sports method.

## THE CONCLUSIONS

Superior improvement in the total physical fitness, as measured by the items in this study, was used as a criterion of physical fitness. The experimental evidence obtained in this study warrants the following conclusions:

1. The sports method was superior to the apparatus method for improving physical fitness.

2. The apparatus method and sports method were equal in improvement in speed of legs.

3. The sports method was superior to the apparatus method for improving arm and shoulder-girdle strength.

4. The apparatus method and the sports method were equal in improvement in jumping or leg strength.

5. There was no significant improvement of one group over the other in arm and shoulder-girdle coordination.

6. The sports method evidenced significant improvement over the apparatus method in body coordination, agility, and control.

7. There was no significant improvement of one group over the other in endurance.

## EDUCATIONAL SIGNIFICANCE

The results of this study are educationally significant in that they have shown first the superiority of one method over another for improving physical fitness in a short period. Second, the results indicate the need for repeating the investigation including in each of the two methods events and activities which will improve the elements which indicated the least amount of gain in this experiment. Third, the results indicate the need for further investigation along the lines of determining the physical fitness value of various combinations of programs of physical education. A method for achieving physical fitness in a short time is needed, especially a method that can be easily adapted by the secondary schools, colleges, and armed forces. A program that has been found to be the best that physical educators can use is a dire need today. Should the results of this study aid toward achieving that objective, its educational significance has been established.

TABLE I

TABLE I

MEASURES OF CENTRAL TENDENCY, VARIABILITY, AND CRITICAL RATIO OF THE APPARATUS METHOD AND THE SPORTS METHOD AT THE FIRST ADMINISTRATION OF THE TEST BATTERY.

| | Group A Apparatus Method | | Group B Sports Method | | Critical Ratio of difference between means |
|---|---|---|---|---|---|
| Event | Mean | S. D. | Mean | S.D. | |
| Total Physical Fitness | 275.3 | 50.22 | 276.02 | 51.35 | .13 |
| 1. Bar Snap | 49.26 | 8.35 | 50.90 | 8.23 | 1.91 |
| 2. Dodging run | 25.99 | 1.40 | 25.90 | 1.93 | .52 |
| 3. Chin | 4.88 | 3.21 | 5.06 | 3.41 | .51 |
| 4. Dip | 4.87 | 3.58 | 5.34 | 4.04 | 1.18 |
| 5. Jump and reach | 16.31 | 2.29 | 16.72 | 2.68 | 1.58 |
| 6. Baseball throw | 171.40 | 31.71 | 165.05 | 34.43 | 1.84 |
| 7. Quarter-mile run | 75.09 | 5.74 | 74.91 | 5.30 | .33 |

TABLE II

MEASURES OF CENTRAL TENDENCY, VARIABILITY, AND CRITICAL RATIO OF THE APPARATUS METHOD AND THE SPORTS METHOD AT THE SECOND ADMINISTRATION OF THE TEST BATTERY

| | Group A Apparatus Method | | Group B Sports Method | | Critical Ratio of difference between means |
|---|---|---|---|---|---|
| Event | Mean | S. D. | Mean | S.D. | |
| Total Physical Fitness | 303.30 | 53.50 | 309.10 | 50.26 | .94 |
| 1. Bar Snap | 52.75 | 9.16 | 54.70 | 9.37 | 2.03 |
| 2. Dodging Run | 25.20 | 1.48 | 25.70 | 1.61 | 3.13 |
| 3. Chin | 6.13 | 3.54 | 8.45 | 3.97 | 5.95 |
| 4. Dip | 6.07 | 3.96 | 6.77 | 4.06 | 1.67 |
| 5. Jump and reach | 18.08 | 2.83 | 19.48 | 3.21 | 1.19 |
| 6. Baseball throw | 174.06 | 32.31 | 171.96 | 34.31 | .58 |
| 7. Quarter-mile run | 72.73 | 5.72 | 73.10 | 5.43 | .59 |

TABLE III

MEASURES OF CENTRAL TENDENCY, VARIABILITY, AND CRITICAL RATIO OF THE APPARATUS METHOD AND THE SPORTS METHOD AT THE THIRD ADMINISTRATION OF THE TEST BATTERY

| | Group A Apparatus Method | | Group B Sports Method | | Critical Ratio of difference between means |
|---|---|---|---|---|---|
| Event | Mean | S. D. | Mean | S.D. | |
| Total Physical Fitness | 318.60 | 37.43 | 341.80 | 36.79 | 5.96 |
| 1. Bar Snap | 54.07 | 9.30 | 57.81 | 4.06 | 3.53 |
| 2. Dodging Run | 24.84 | 1.39 | 24.76 | 1.31 | .57 |
| 3. Chin | 6.71 | 3.57 | 8.03 | 4.23 | 3.22 |
| 4. Dip | 6.76 | 4.56 | 8.41 | 4.27 | 3.59 |
| 5. Jump and reach | 19.03 | 2.66 | 20.78 | 3.02 | .58 |
| 6. Baseball throw | 179.35 | 32.11 | 186.01 | 34.22 | 1.92 |
| 7. Quarter-mile run | 72.07 | 5.48 | 70.98 | 5.71 | 1.85 |

# Yale University Completes One Year of Its Wartime Physical Training Program

By Lt. Thomas W. Murphy
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*Groton, Mass.*

THE Yale Plan[1] of general preparation brings together courses by which the students may be better developed in order to most effectively serve the armed services. Taken together, these courses form a coherent plan of preparation for war service, an adaptation of the programs of Yale College and the non-technical programs in the Sheffield Scientific School to fit the students' immediate wartime needs. An accelerated school year of eleven months was inaugurated.

The university, as well as the armed services, have recognized that good health and hard physical condition can be assured only by rigorous physical training. In line with the nationwide program to improve the physical fitness and organic stamina of American manhood the university instituted a required course in physical education for all undergraduates. The program was designed to make its students physically fit and efficient for the present-day demands of life and to aid them in meeting the adjustment between the physical demands of civil and military life.

In connection with the medical examination given by the University Health Department, a complete orthopedic check-up is given to each member of the incoming freshman class and a posture photograph is taken. Those students who show defects of posture or other remediable orthopedic defects[2] are assigned to specific corrective classes to fit their needs. A swimming test is also given to all freshmen in order to determine their ability to enter the water and swim one hundred yards. A student unable to meet these requirements must attend a beginners' swimming class until he can pass the test.

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* Instructor in physical education, Yale University, at the time the data in this study was compiled.

[1] For a more detailed discussion of the Yale Plan, see "Student Preparation for War Service," *Bulletin of Yale University*, No. 7, April 1, 1942, pp. 4-24.

[2] J. S. Wickens, and O. W. Kiphuth, "Common Postural Defects of College Freshmen," *Research Quarterly*, 13:1 (March, 1942) 102-8.

Preparatory to setting up a testing program, members of the Yale physical education staff visited several of the military camps to gather the essential activities and test items required in a war fitness program. Military authorities responsible for the physical condition of the men in their camps were in agreement that particular emphasis should be placed on those activities which strengthened the arms and upper trunk, the abdominal region, and the legs. These men were most emphatic in stating that, in order to "pass the ammunition," dig fox-holes, slit trenches, and do other manual labors connected with combat duties, strong arms and trunks are necessary. If a man is to have endurance and organic stamina then his midsection must be in good condition. If he is going to be able to cover the marching with packs over rough terrain then his legs must be strengthened to carry this daily strain.

With the above in mind, the following motor and physical fitness tests were devised and administered to all undergraduates:

1. *Chest Measurement.*—This measurement was primarily included because of the chest expansion index, which is required in the armed services. It is taken with an anthropometrical tape (Gulick Spring Attachment) at the level of the nipples, and reading taken at maximum inspiration and maximum expiration.

2. *Hand Grip.*—Using a hand dynamometer, each student was given two trials with the right and then with the left, and the best reading of each hand was recorded.

3. *Push and Pull.*—The Narragansett Attachment with the dynamometer for testing strength of the pectorals and the retractors was used in this item. Each man was given two trials and the best readings for the pectorals and the retractors were recorded.

4. *Fence Vault.*—For this test, the horizontal bar was placed at four feet, six inches. Gripping the bar with both hands the student was required to vault over, without touching legs or hips and land on his feet facing straight ahead, in order to pass. For those who did the test with a one-half twist, it was so recorded but not considered passing.

5. *Chin-Ups.*—Each end of an overhead ladder was used in checking chin-ups. Using a reverse grip, hanging with the arms extended the student was required to pull his body up so that his chin was at the top level of the rung. No kipping was allowed and the arms had to be extended completely on returning to the original position each time.

6. *Standing Broad Jump.*—A mat was marked off for jumping purposes. The markings included a take-off line, allowing just enough room for the jumper to have his feet entirely on the mat. Three feet from the take-off line similar lines were drawn, one inch apart and extending along the mat until a total of nine feet was marked. Measuring was done from the take-off (standing behind the line) to the closest heel prints at the landing position. The individual was allowed two jumps, the best result was recorded.

7. *Vertical Jump.*—A blackboard was marked off in inches and secured to the wall. The individual assumed his best reaching height with chalk, then pretended to be taking a held-ball jump position in basketball. At the height of his jump he marked the board again. Three jumps were allowed each in-

dividual, the best being recorded. The reaching height was subtracted from the jumping height. The difference in inches was considered his score in ability to explode his own body weight into the air.

8. *Trunk Raising* (Sit-ups).—Start from a sitting position, feet together with hands clasped behind the neck. The feet should be held stationary, either by hooking the toes behind a bar, six inches from the floor, or by having another individual hold the ankles. He should start backwards touching a "bumper"* lightly about four inches from the floor, and placed so as to touch directly across the upper part of the shoulder blades. On coming to an erect position he should touch his right elbow to the left knee and then immediately repeat the exercise and touch the left elbow to the right knee. No resting or bouncing should be permitted on the bumper and he should be urged to keep his legs as extended as possible.

9. *Dips* (*On parallel bars*).—A set of floor parallels were placed on top of two horses about face high. A two-foot bench was used to start the individuals. They jumped to a front leaning rest, grasping the parallels near the ends, while the bench was moved out of range. A dip was completed when the individual lowered himself forming right-angles with his arms and then returning to the rest position. To protect the individuals from going too low, a rubber band was attached to extensions above the bars at approximately chin height. The individual was not allowed to rest between dips, but continued steadily until *unable* to do more.

10. *Rope Climb* (24' standing position).—Each boy was timed and allowed to use any method he wished, that is hands alone, or hands and feet. Much supervision was necessary to prevent boys from being careless while coming down the rope, or on attempting to climb becoming too tired so that there was danger of letting go entirely. Chalk powder (Magnesium Carbonate) was furnished for the hands.

11. *Brouha Step Test*[3] (Stool-stepping for five minutes).—Benches were provided, twenty inches in height. The boys were either barefooted or wore sneakers. The procedure was explained before each test. Time or rhythm was beaten out with a pole on the floor. A stop watch was held by one instructor who called out each minute as it was completed. The boy could lead with either foot but whichever one he used to step up with, he also had to use to step down. All boys had a "counter" assigned to them so that at the finish the "counter" could count the boy's pulse recovery. The rhythm was regulated so that thirty completions (up and down) were done each minute. This test demonstrated foot pounds of work and is easily learned, needing no special skill training. Any boy getting out of step was helped to get back into stride, but after three minutes, if a boy could not keep up he was stopped and marked according to the minutes completed. After five minutes all boys sat down if they completed the test.

During the first minute the "counters" adjusted themselves to the speed of the boy's pulse, using the carotid artery as the simplest place to count. The pulse was counted between the one to one and a half, two to two and a half, and three to three and a half minute periods. These three readings were totaled and a grade was taken from the conversion Table I. The grade was on the basis of one hundred for a perfect score. There were occasional scores above one hundred.

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* A "bumper" is a 2" by 4" block of wood, 2 feet long.

[3] L. Brouha, M.D., "The Step Test: A Simple Method of Measuring Physical Fitness for Muscular Work in Young Men," *Research Quarterly*, 14:1 (March, 1943) 31-35.

TABLE I
BROUHA STEP TEST
(Duration of Exercise 300 Seconds or 5 Minutes)
CONVERSION SCORE TABLE

(If the boy made a low total Recovery Rate, it indicated a high Fitness Index.)

| Recovery Rate | Fitness Index 0 or 5 | Fitness Index 1 or 6 | Fitness Index 2 or 7 | Fitness Index 3 or 8 | Fitness Index 4 or 9 |
|---|---|---|---|---|---|
| 150 | 100.0 | 99.3 | 98.7 | 98.0 | 97.4 |
| 155 | 96.8 | 96.2 | 95.6 | 95.0 | 94.3 |
| 160 | 93.8 | 93.2 | 92.6 | 92.0 | 91.5 |
| 165 | 90.9 | 90.4 | 89.9 | 89.4 | 88.8 |
| 170 | 88.3 | 87.8 | 87.2 | 86.8 | 86.2 |
| 175 | 85.7 | 85.3 | 84.7 | 84.3 | 83.8 |
| 180 | 83.4 | 83.0 | 82.5 | 82.0 | 81.5 |
| 185 | 81.1 | 80.7 | 80.2 | 79.8 | 79.4 |
| 190 | 78.9 | 78.6 | 78.1 | 77.7 | 77.3 |
| 195 | 77.0 | 76.5 | 76.2 | 75.8 | 75.4 |
| 200 | 75.0 | 74.6 | 74.3 | 73.9 | 73.5 |
| 205 | 73.2 | 72.9 | 72.4 | 72.1 | 71.9 |
| 210 | 71.4 | 71.2 | 70.7 | 70.4 | 70.1 |
| 215 | 69.7 | 69.4 | 69.1 | 68.8 | 68.5 |
| 220 | 68.2 | 67.9 | 67.6 | 67.2 | 67.0 |
| 225 | 66.7 | 66.4 | 66.1 | 65.8 | 65.5 |
| 230 | 65.3 | 64.9 | 64.7 | 64.4 | 64.1 |
| 235 | 63.9 | 63.6 | 63.4 | 63.1 | 62.8 |
| 240 | 62.6 | 62.3 | 62.0 | 61.8 | 61.5 |
| 245 | 61.3 | 61.0 | 60.8 | 60.5 | 60.3 |
| 250 | 60.0 | 59.8 | 59.6 | 59.3 | 59.1 |
| 255 | 58.8 | 58.6 | 58.4 | 58.2 | 57.9 |
| 260 | 57.7 | 57.5 | 57.3 | 57.0 | 56.9 |
| 265 | 56.6 | 56.4 | 56.2 | 55.9 | 55.7 |
| 270 | 55.5 | | | | |

## ORDER OF EVENTS AND RECORDS

The tests were administered as numbered above and all except the Brouha Step Test were given on the first day. The Step Test was given separately on another day. There was time for the boy to get at least a few minutes rest between strenuous tests. All boys were urged to do their best on each test.

Each boy carried a Motor and Physical Fitness Test Record card from station to station and the instructor recorded his score as each test was finished. Table II gives the summary of the results of these tests.

## STANDARDS

Upon examination of the Army Basic Field Manual,[4] Naval Statistics of Enlisted Men at Norfolk, Naval Statistics of Chief Specialists (Physical Instructors) at Norfolk and numerous College Instructors Majors' Standards, we arrived at the conclusion that Yale's Standards would be practically the average scores of the three thousand undergraduate students. These standards are listed in Table III.

[4] War Department, *Basic Field Manual: Physical Training*, 1941. pp. 5-6.

TABLE II

| Name of Item | No. of Cases | Average | Range |
|---|---|---|---|
| 1. Chest expansion | 3182 | 2.64 inches | 0.6 - 6.0 inches |
| 2. Grip, right | 3165 | 124.5 lbs. | 56 - 205 lbs. |
| Grip, left | 3171 | 114.2 lbs. | 54 - 200 lbs. |
| 3. Push (Pectorals) | 3185 | 107.0 lbs. | 36 - 190 lbs. |
| Pull (Retractors) | 3171 | 93.5 lbs. | 36 - 180 lbs. |
| 4. Fence Vault (4'6") | 3154 | 1857 (58.8%) passed | |
| | | 398 (12.6%) vaulted, but with half-twist | |
| | | 899 (28.6%) failed | |
| 5. Chin-Ups | 3163 | 8.82 times | 0 - 25 times |
| 6. Standing Broad Jump | 3130 | 84.86 inches | 40 - 110 inches |
| 7. Vertical Jump | 3130 | 18.24 inches | 5 - 28 inches |
| 8. Trunk Raising | 3136 | 50.1 times | 0 - 200 times |
| 9. Dips | 3153 | 8.48 times | 0 - 27 times |
| 10. Rope Climb (24') | 3120 | 19.4 sec. (passed) | 6 - 43 sec. |
| (standing position) | | 12.5 feet (failed) | 0 - 19 feet |
| | | 1583 (50.7%) passed | |
| | | 1537 (49.3%) failed | |
| 11. Brouha Step Test | 2882 | 79.23 index no. | 59 - 120 index no. |
| | | 254 (8.7%) failed to finish | |
| Freshman Posture Statistics* (Objective Measurements from Photograph)[5] | | | |
| Head and Neck | 5160 | 57.05 degrees | 37 - 75 degrees |
| Chest | 5150 | 50.98 degrees | 30 - 69 degrees |
| Overcarriage | 5171 | 86.84 degrees | 77 - 95 degrees |
| Kyphosis | 5172 | 159.9 degrees | 134 - 180 degrees |
| Lordosis | 5168 | 159.2 degrees | 132 - 180 degrees |

TABLE III

1. Fence Vault — 4 feet 6 inches.
2. Chin-Ups — 10 times.
3. Standing Broad Jump — 86 inches.
4. Vertical Jump — 18 inches.
5. Trunk Raising — 50 times.
6. Dips — 10 times.
7. Rope Climb — top (24 feet, standing position).
8. Step Test (endurance) — finish 5 minutes.

The physical education program required of all undergraduates at Yale is as follows:

1. Medical Examination.

2. Boys who do not meet the Orthopedic Requirements for good posture (Freshmen) are assigned to corrective classes.

3. Those boys who fail the 100-yard swim test are assigned to compulsory swimming.

4. Boys who fail to meet the standards in motor and physical fitness tests are assigned to physical fitness classes.

5. Boys[6] who pass the above requirements in the first week may

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* The writers are indebted to Oscar Kiphuth of the Yale staff for his part in compiling these statistics.

[5] J. S. Wickens and O. W. Kiphuth, "Body Mechanics Analysis of Yale University Freshmen," *Research Quarterly*, 8:4 (Dec., 1937) 38-48.

[6] E. D. O'Donnell, and M. Stevens, M.D., Lt. Comdr., *Hand-to-Hand Combat* (New York: Street and Smith Publications, 1943).

choose War Swimming for the Sophomore Year and Hand-to-Hand Combat for the Junior Year.

6. Varsity Sports. Boys who pass their requirements may choose any one of the following varsity sports in season: football, basketball, swimming, wrestling, squash, lacrosse, soccer, hockey, fencing, baseball.

7. Intramural Sports. Boys who pass their requirements and cannot make a varsity team may choose any one of the following intramural sports in season: football, soccer, basketball, boxing, wrestling, lacrosse, baseball, squash, hockey, fencing, tennis.

8. Optional Gym Activities (individual or dual): boxing, life-saving, fencing, jiu jitsu, swimming, body building, handball, war swimming.

Attendance is required on three different days each week. Any boy who was in the required program could also compete on intramural teams, but his attendance credit was taken in his required activity.

## PROGRESS IN PHYSICAL FITNESS

The program at the beginning placed almost one-third (1000) of the student body in the fitness classes because of failure in one or more of the tests. Approximately every four weeks boys in fitness classes were given an opportunity to try to pass the tests. If successful they could register for another activity for their gym credit.

## PHYSICAL TRAINING PERIODS

The periods were divided into eight weeks each. At the beginning of the spring term, March 20, 1943, the number in the student body amounted to 1670 boys. The distribution of these boys in the different activities is shown in Table IV.

TABLE IV

| | | |
|---|---|---|
| Work in gymnasium: | | |
| 1. Correctives | 5 | |
| 2. Physical Fitness | 260 | |
| 3. Body Building | 139 | |
| 4. Special Exercise | 28 | |
| 5. Commando (E. R. C.) | 7 | |
| 6. Boxing | 90 | |
| 7. Jiu Jitsu | 150 | |
| 8. Fencing | 22 | |
| 9. General Swimming | 67 | |
| 10. War Swimming | 198 | |
| 11. Red Cross Swimming | 3 | |
| | 969 | Total |
| Varsity and Intramural Sports: | | |
| 12. Baseball | 158 | |
| 13. Soccer | 130 | |
| 14. Lacrosse | 136 | |

| | |
|---|---|
| 15. Tennis | 117 |
| 16. Golf | 19 |
| | 560 Total |
| 17. Excused | 141 |
| | 1670 Grand Total |

Since Pearl Harbor, educators have been anxious to adopt a wartime program that would develop the physical well-being of the students as well as foster such qualities of character as self-confidence, courage, and the ability to act quickly and effectively in difficult situations. The term, "physical fitness," has taken on added significance in this program directed toward the conditioning of those serving in the military forces and on the home front. The results of the above tests have played a large part in shaping Yale's physical fitness policy in time of war. They reveal conclusively that although some averages are higher than minimum military standards, there are many men of college age preparing for military service who are not physically fit and are lacking in many of the essential qualities which make for physical fitness. In chin-ups, 60 students could not lift their body weight off the floor, and 762 (24 per cent) could not chin themselves more than 5 times. One hundred and fifty-six were unable to push up their body weight in the parallel bar dips, and 979 (31 per cent) could not do more than 5 dips. Three hundred and thirty (10 per cent) could not do trunk-raising more than 25 times. In the step test 254 (8.7 per cent) were unable to complete the 5-minute test, while 777 (27 per cent) fell below the score of 75 which Dr. Brouha considers as average condition. While the writers have not attempted to correlate this test statistically with other elements of physical fitness, it was noted that in the class of 1945 alone there were 121 members who fell below the score of 75; of this number taking all of the motor and physical tests, 54 failed from 1 to 4 items while 50 failed 5 or more of the tests. The same approximate proportions existed in the other classes. Postural fitness is another phase of physical fitness deserving of much attention and interest. There is a surprisingly large number of individuals at the college level who could benefit from body mechanics' education and corrective work, particularly in those postural items referred to in this study. The military services realize the importance of good posture in connection with the appearance of its officer and enlisted personnel. They are concerned with the reduction in the efficiency of physiological functioning of the vital organs in the case of bad posture. These weaknesses and deficiencies in the incoming men sadly handicap the military services in their effort to prepare men for combat duty. Yale has emphasized its responsibility for the physical fitness of its men

training to serve in the armed forces. Every undergraduate must now satisfy minimum requirements in each of the tests mentioned above and attain basic proficiency in endurance, water-safety skills, and hand-to-hand combat before electing team sports exclusively.